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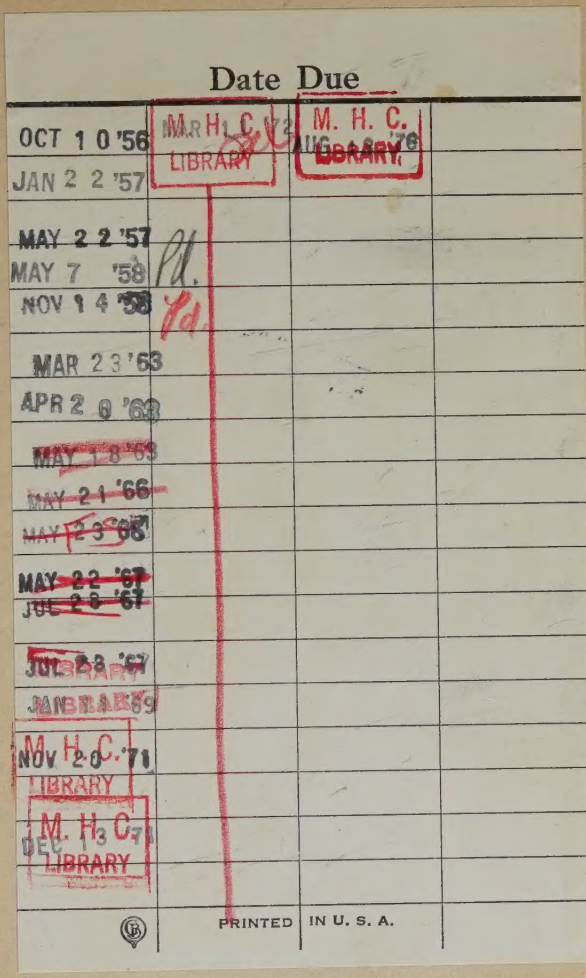

A MANUAL OF INDIVIDUAL MENTAL TESTS AND TESTING

JUDGE BAKER FOUNDATION PUBLICATION NO. 4

JUDGE BAKER FOUNDATION PUBLICATIONS

1. HARVEY HUMPHREY BAKER, UPBUILDER OF THE JUVENILE COURT. 1920.
   A memorial volume with data of the Boston Juvenile Court.

2. JUDGE BAKER FOUNDATION CASE STUDIES, *Series I.* (By W. H. and A. F. B.) 1923.
   A series of 20 conduct problem cases.

3. DELINQUENTS AND CRIMINALS, THEIR MAKING AND UNMAKING. (By W. H. and A. F. B.) 1926.
   A comparison of series of delinquents and their outcomes in Chicago and Boston.

4. A MANUAL OF INDIVIDUAL MENTAL TESTS AND TESTING. (By A. F. B., W. H., G. M. L. and M. E. S.) 1927.

A MANUAL OF INDIVIDUAL MENTAL TESTS AND TESTING

DISCARD

BY

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PREFACE

Investigation of the mental capacities of human beings may rationally be considered a matter of prime importance for the individual and for civilization. To any objections that the procedure suggested in this manual is impracticable, requiring too much time or costing too much, there are sound enough answers. Mental powers are so numerous and diverse that short examinations are not likely to reveal them; inaccuracy of psychological diagnosis and prognosis results in positive harm to the individual and hinders the development of scientific psychology. The cost of as thorough testing and interpretation as can be made in the interest of better educational and social adjustments is very slight as compared to the expenditure that is undertaken by way of society's treatment of the individual in schools and, in the exceptional cases, by courts, institutions, and agencies that care for children.

The human individual is certainly worth the cost of every scientific attempt at bettering his development and conditions of life. As it is, study of mental aptitudes and capacities takes a place in importance far below that of investigation of the working possibilities of a machine — the diagnosis of why the family automobile is not doing its best is willingly paid for when a similar study of the child's potentialities is not even recognized as a possibility.

It will be readily perceived that the production of this manual has required an immense amount of work; months have been spent in better development of tests, as well as in thorough review of the literature and actual preparation of the manual. In organizing and preparing the material for publication, by far the major parts have been played by Myra E. Shimberg and

Gladys M. Lowe. Determination of statistical procedure, much of the detailed work and supervision of assistants is to be credited to Miss Shimberg. Those responsible for the development and standardization of certain tests, mainly the above and Marjorie C. Meehan, receive personal acknowledgment under the head of the various tests.

In the initial stages Miriam Wood Hazeltine and Charlotte Ring Spivak of our own staff worked on this manual. Miss Meehan has rendered most intelligent and invaluable services of various sorts over a long period. Graduate students, from Boston University Miss M. L. Penny and Mrs. Bertha Rice, from Wellesley College Miss Regina Stolz, have undertaken special tasks. Mr. David Barnes, architect, gave freely of his professional skill for the Floor-plan Test, the standardization of which was accomplished through the coöperation of high-school groups in Newton and college groups at Harvard, Wellesley, and Boston University.

For data useful in establishing norms and for contributing actually completed norms we are indebted to Doctor James S. Plant, Jeanette Regensberg, Doctor H. H. Young and D. C. Daugherty, Doctor L. L. Thurstone, and Doctor Grace H. Kent. Doctor Kent also most generously offered much of her original material not yet published elsewhere.

Opportunity for gathering needed data on unselected school groups has been possible through the courteous coöperation of Mr. Roger Cochrane, assistant superintendent, Quincy, Mass.; Mr. Lee T. Gray, principal of high schools, Portsmouth, N. H.; Miss Florence Whittemore, dean of high school, Beverly, Mass.; Mr. G. Murray, principal of the Phillips School, Salem, Mass.

We also are indebted to teachers in Portland, Oregon, and Springfield, Illinois, for sending results on our Scaled Information Test. Professional students in our classes at Boston University have also given unstinted services in gathering data.

The manual, as it stands, would have been quite impossible without the splendid spirit shown by all these and by others; Judge Frederick P. Cabot and the other trustees of the Judge Baker Foundation have steadily encouraged our attempts to

gain more knowledge and improve the technic for better understanding of the problems of childhood and youth.

For the general conception of the work and the points of view expressed in the introductory chapters, and for any shortcomings we hold ourselves responsible.

A. F. B.
W. H.

Boston,
January, 1927

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PART ONE

INTRODUCTORY

A MANUAL OF INDIVIDUAL MENTAL TESTS AND TESTING

PART ONE

CHAPTER 1

Introduction

Mental testing requires no justification; the rapid growth of belief in its value has in many ways proved to be well warranted. However, at the present time, two great needs appear: First, to combat the uncritical acceptance of very narrow and simple measurements as offering adequate criteria for judgment of mental capacities. Extraordinary assumptions are constantly made on the slender basis of some numerical statement, supposed to symbolize an individual's mental ability *in toto*. And, second, as a correlate to this, there is great urgency for utilization of a much wider range of tests that the human individual may be better known in regard to his various mental capacities, in order to relate his abilities to his possible social, educational, vocational adjustments and achievements.

This manual aims at rendering service to these ends; from the present development of the field of mental tests and testing it offers methods, data, interpretations, and references of practical bearing on the above points.

It is from daily experience during long years, studying young people of various ages and of greatly differing capacities, that the point of view embodied in this manual has been evolved. Our work with mental tests began even before the Binet-Simon age-level series was available and has been steadily continued, always with the policy of trying new tests and new methods as

they promised to have practical import. Our opinions and procedure have been developed not from academic interest, but ever under the urge of meeting actual situations in individual lives.

Studies of the individual have with us meant case studies, mental testing being one part of the procedure. In a great majority of instances we know later careers, while in not a few cases have there been actual re-studies by us or comparisons with the findings of others who have tested or studied the same young person.

Specifically, then, this manual is the outgrowth of attempting to do really good work in mental testing as part of the basis for advice about educational, personality, and conduct problems. It long ago became clear that practical adjustments could best be made only when there was determination of facts concerning a wide range of mental abilities. We, therefore, have been desirous of acquiring as much knowledge concerning the individual's abilities and disabilities as it has been possible to gain.

It has been plain that as more tests were developed and utilized we have achieved better and better understanding of the individual's special capacities, understanding that was of great value in helping him. So our tendency has been to increase the number of tests used rather than to curtail the list. Some examiners, perhaps under the stress of special conditions, have selected experimentally a few tests with high statistical reliability, and with very brief testing by means of these so-called " elimination tests " have classified according to " intelligence groups ", and upon these limited findings have based recommendations. Our convictions and practice have been in the opposite direction.

The most widely used brief procedure, however, is to confine mental testing to an age-level scale. Now, such measurement of a supposed " general intelligence " is of real value in studying mental abilities. The so-called mental age and intelligence quotient, even as they are at present developed, help considerably in orientation concerning the individual. Without belittling this fact, it seems equally evident that a numerical general evaluation must be very limited in its revelations. The

age-level scales contain comparatively few of the tests that are available for gaining knowledge concerning the many different mental capacities, and as put together they form a hodgepodge. Just what the separate tests measure is not known, and the values given for success in each are quite arbitrary.[1]

While our age-level scales are often spoken of as determining so-called "general intelligence", yet there is an abundance of evidence that the rating achieved is markedly influenced in some cases by highly specialized abilities or disabilities. We could, for example, cite many illustrations showing that the mental age and intelligence quotient according to the Stanford-Binet scale have been advanced immensely by the individual having unusually good auditory span for digits. A case in point, no more exaggerated than many others, is: B, chronological age 15 yrs. 6 mos., mental age 13 yrs. 4 mos., I.Q. 86, grading thus, according to Terman's classification, in the dull normal group (by the army findings very near average American intelligence). Analysis of separate test results reveals that 21 months of this credit above the 12-year level are due to passing on the 14, 16, and 18-year levels the auditory memory span for digits forwards and backwards. Were it not for this specialized ability B's mental age would be 11 yrs. 7 mos., I.Q. 75, thus grading as in the border zone between normality and mental defect. And even in regard to tests involving language, we may assert that our experience shows that there are great special differences in the facility for acquiring and handling words. Now and again we find an otherwise defective person with really good language powers, or an otherwise mentally normal person who, in spite of normal opportunities, is not at all up to the average in acquirement and use of an ordinary vocabulary.

Or, concerning the effect of cultural opportunities upon age-level ratings, we must remember that those who have had poor chances for acquiring the usual vocabulary are heavily penalized

[1] We need not here go into this matter in detail, but we are thoroughly in accord with the opinion of Thorndike, expressed in his article in the *Psychological Review*, May, 1924. He states concerning "intelligence tests" that they have three fundamental defects: (*a*) ambiguity in content of the tests; (*b*) arbitrariness in the units of measurement; (*c*) ambiguity in significance.

because of their failures on the vocabulary list and other word tests which come so frequently in the Stanford-Binet scale. We are well aware of the experiments showing the value of language-usage tests for estimating the development of general intelligence, and, granted equal opportunities and no very special ability or disability for language acquirement, this is a valid point. But opportunity is not a negligible factor in the interpretation of results when a child is brought up in a home where a foreign language is spoken and in a neighborhood where ordinarily good English is not the common avenue of expression. It is quite unfair to grade this child, or the child who comes from an untutored American family, by a scale so largely embodying vocabulary and language tests, as on a par with the child from an English-speaking home of good culture; the latter has too great an advantage in these matters.

And so it is perfectly clear that for the eminently practical purposes of really knowing an individual's mental capacities and acquirements, there is much more to mental testing than giving an age-level general rating. One of the ablest proponents and critics of mental testing, Thorndike, has well said that "the facts of everyday life, when inspected critically, indicate that a man has not some one amount of one kind of intelligence but varying amounts of different intelligences. . . . No man is equally intelligent for all sorts of problems." For ordinary practical purposes, he goes on, we should examine for three "intelligences" — abstract, mechanical, and social. Now, social intelligence is difficult satisfactorily to test and is much bound up with the traits and urges and emotional qualities of the individual which, for any sort of satisfactory appraisal, require a study of the personality. But it is certainly possible to form some estimate from test results of the other two "intelligences" of which Thorndike speaks.

Even though the standard age-level tests utilize proportionately so much representative material and so largely involve abstract ideas, yet even in these fields there is very much more that can and should be learned about an individual's capacity for memorizing, analyzing, generalizing, reasoning, mentally representing. In our practical studies of cases we have found much reason to welcome development of tests for these capac-

ities and now to include them in this manual. Through them greatly increased knowledge of capabilities is to be gained.

Then it is a rather generally recognized fact that " intelligence " rating scales indicate very little concerning ability to deal with things, with concrete material. On account of this, some of us began early in the development of testing to work on tests for perceptive and apperceptive abilities as related to non-verbal material. Through the development of such tests it has now become possible to discern that many individuals have very special abilities of this kind, sometimes quite apart from manual dexterity. The " manual-mindedness ", undoubtedly often merely meaning dexterity, long recognized by school people as opposed to " book-mindedness ", may or may not be allied to a special ability for understanding and seeing through situations presented in concrete material. Worth much for discrimination of the different capacities that are involved in dealing with concrete material are a number of the tests presented in this work.

For our part, we may insist that one cannot deal with children day after day, meeting them at close range, attempting to discover their various abilities, without an ever-increasing realization of the great differences that they present. It might be thought that, in spite of variations, many generalizations would be possible and new problems could be readily soluble in terms of old experience. This proves, however, not to be the case. So complex and intricate is mental life and so great the interplay between different factors in the production of mental output, that combinations appear ever new to challenge the student of human nature. There is hardly a single feature in the make-up of the individual or of his environment that may not in some particular instance play a significant part. Moreover, the interaction between the individual and his situation is in constant change.

Each individual child and adolescent coming for study (only a small number of them at all abnormal) presents an entirely different problem. Sometimes, and among the bright as well as among the dull, it is a question of educational or vocational import; with others it is a matter of conduct trends or personality traits. In every instance there is need for estimating the

various mental strengths and weaknesses of the individual, and practical advice should be given only when such estimates receive full consideration.

There is no gainsaying that one of the really useful tools in diagnosing and constructively solving the problems of young people is good mental testing. But we cannot conceive of this as a routine measure or as merely a classification of the individual in set general terms; above all, not in the glib numerical evaluations (Intelligence Quotient 75, or 92, or 120, etc.) which are in line with the cheaper fashion of the day. Psychological testing conceived of in a larger way has significance and value because of its place in the greater task, that of understanding the whole personality. To those who have discovered the light that testing sometimes throws on the hidden subtleties of the problems of young people, this will be a truism.

There is great temptation to give here by way of illustration some actual case problems and the relation to them of findings by mental testing, but this is hardly the place for such material. However, this work may be regarded as elaborating part of the technic used in studying the cases which were presented in the "Judge Baker Foundation Case Studies, Series I", a set of twenty rather thorough case studies of conduct problems. More particularly, however, we hope we are offering prolegomena for future presentation of case problems illustrating in various aspects the educational significance of psychological test results. One interesting set of findings is offered in the chapter on Practical Procedure where we give an example of the value of using a fivefold system of comparing abilities of an individual.

As one works day in and day out with young people, presenting many differences of physical make-up and from all sorts of home and neighborhood conditions, one has innumerable illustrations of the interrelationships that exist and modify mental performance. It surely is not necessary to illustrate the bearing that sensory defects, bad eyesight, and defective hearing have upon test results; yet these sometimes are unknown or overlooked by the examiner. Much less recognized by psychologists and educators who test children are other conditions which influence work on tests. An example is chorea, a dis-

order which seems not to be understood for its peculiar and long-persisting disabling effect upon the ability to control mental powers. For similar reasons the examiner should be watchful for various other physical conditions. The most frequent of these complications can be suspected by any intelligent person who has taken the trouble to become acquainted with them, and can be verified by medical consultation.

Also, not to take into account the emotional state, or varying states, of the subject during testing, as bearing particularly upon the quality of the response elicited by the examiner, means overlooking one of the most important factors in results. Then the background of social environment and of mental experience forms matters for serious consideration, both in giving and interpreting mental tests.

With these far-from-negligible considerations in mind, we can but wonder at the crudity of using psychological tests in any mechanical way, giving them in a stereotyped manner as if human beings were machines, and recording and interpreting them in a narrowly standardized fashion. As if such results were reliable and of final value! To be blind to the complexity that so definitely exists betokens intellectual weakness on the part of the observer.

While discussion of some of the specific points which must ever be borne in mind in the giving of tests and the evaluating of results is to be found in the chapter on Practical Procedure, here we should perhaps say that, obvious as many of these matters would seem to be, we have observed numerous instances where there has been gravest disregard of such common-sense fundamentals. Tests, especially those of the usual age-level series, are given by clerks, nurses, physicians who have had absolutely no training in this field, most important judgments are handed out by those equipped by only a few weeks of practice. Tests are given, an intelligence quotient recorded, the individual labeled, and perhaps to some extent his fate determined, as if the determination of mental powers were merely an affair of mechanically weighing him.

More curious, even, than this, and as unscientific, is the loose procedure by which there is gathering of information about different aspects of the individual without clearly envisaging

interactions and interrelations, especially as they bear upon mental performance. Specifically, if the physician, the psychologist, the psychiatrist, the social investigator all make their studies and reports separately, without conference and without appreciation of how their findings may have been affected by factors in other fields, the result is often most unfortunate for any thoroughly good adjustment of the situation. The only possible way of arriving at safe conclusions about the individual is through modifying judgments by pooling information. Separate, discrete judgments bring science into disrepute and, worst of all, hinder the best being done for the person investigated. The psychological study should not be apart from all the rest of the study of the individual. Mental testing gives valuable information, but, in turn, all possible light from other information about the person tested should be shed upon the results of testing.

Even though mental testing as a science is of such recent growth, the accumulation of data concerning it has already reached huge proportions, as may, indeed, be seen by the reference material of this volume. For some time it has been obvious that a manual of individual tests is greatly needed, a work that would bring together and to some extent systematize and make available many valuable tests, some of them little known.

On account of the present broad development of mental tests and testing, such a manual as this is highly desirable both for college students of psychology and for the training of psychologists for practical work. Moreover, on account of the vast collection of facts that must be at the constant command of those who are doing good mental testing, there is need of this presentation of material for frequent reference.

Then, too, we have in mind the consideration that, as in other sciences, exhibition of the equipment and methods which represent the best that has been developed in this field will go far towards winning greater appreciation of the values of mental testing. School people, in particular, as well as psychiatrists who deal with special problems of the young, can readily perceive from this manual that it is part of their business to know how and to what extent human capacities can be measured.

As many articles in periodicals bear witness, nowadays there is widespread interest in the study of mental abilities. All intelligent people who wish to inform themselves concerning one of the most significant scientific movements of recent times may well turn to a practical work on the subject.

Our entire treatment of mental tests and testing is based on the fact that there are differences in mental capacities between individuals and in the same individual. Whatever the fate of the controversial conception of a factor of " general intelligence " which metes out all mental performance and itself is what mainly varies from individual to individual, it surely for practical purposes will be conceded on all sides that specific abilities and disabilities exist in each human being, whether or not these are due entirely or in part to environmental conditions, earlier experiences, or to original endowment. Though from any mental performance we may not yet be able to decipher primary inherent capacities of various sorts, we are not barred from measuring present capabilities, any more than the physicist is prevented from practically dealing with matter because he does not know its component parts. As a matter of fact, experimentation with mental tests is much more likely to throw light on native endowment and original potentialities than any amount of theoretical discussion. We may speak of intelligences rather than intelligence, or we may generalize capacities into various categories, perhaps eductive and reproductive; yet there ever remains necessity for many mental measurements if we are to know the individual.

The scope of this manual is very definitely limited. We give in detail only tests which stand by themselves; groups of tests, " omnibus tests ", which afford only a composite rating made up of many heterogeneous elements we merely mention. Educational, vocational, industrial, temperament tests and scales are only touched on lightly. Foreign tests find little representation in this work on account of doubt of their applicability to American subjects.

The manual contains in concise form all the information necessary to give, score, and numerically evaluate a very considerable range of tests, the largest number so far collected in any volume. We have attempted to include every adequately

standardized individual test of mental ability. Tests, many of them valuable, for which no reliable norms are as yet established, are given in a separate section of Part II. Part III is entirely devoted to discussion and interpretation of the tests. Part IV contains a short account of supplementary fields of testing; with the emphasis on critical references rather than on discussion. A very complete bibliography pertaining to individual tests and to testing has been painstakingly prepared.

It will be seen that we have been quite willing to discard old tests for better and have shown little desire to originate new ones as such; it has been only when old tests are unsatisfactory or the ground is not covered that we have made an effort to originate needed material.

Our endeavor has been not only to develop a practical manual for everyday use, but also to gather cumulative evidence from many sources concerning the significance and worth of the tests included. Our science is new, the treatment of the subject at many points is necessarily partial, and discussion is not closed.

CHAPTER 2

Practical Procedure

FAVORABLE CONDITIONS FOR TESTING

That the results of the psychological examination may be reliable and have significance, two conditions are absolutely essential, namely, a competent examiner and a coöperative subject.

The phrase " competent examiner " necessarily implies thorough training and thorough training means a well-rounded theoretical background supplemented by special study of the field of mental testing, together with sufficient experience in the giving of tests to insure that mastery of the technic of testing which no amount of reading can supply. Mental life is extremely complex, and for appreciation of its subtleties and variations serious study is required. It is for this reason that we have always been opposed to the summer school or other brief course as preparation for giving and interpreting psychological tests. Nowadays a distinction is made by many between the psychologist and the psychometrist; but even knowledge of mere psychometrics should presuppose something more than an acquaintance with a handful of tests and a routine method of administering them. The use of an age-level scale, or of that supplemented by a few other tests, given without variation to each individual and routinely scored without interpretation, is fraught with much danger, we believe.

Aside from suitable technical equipment, the examiner must also be particularly fitted in personality to win interest and coöperation from the subject. Good *rapport* is an absolute essential; it is self-evident that responses from an uncoöperative subject are entirely meaningless. Failure to pass a test necessitates determining whether this is due to lack of interest,

unwillingness to respond, emotional inhibitions, physical conditions, or lack of mental capacity. The considerations outlined in the following paragraphs represent a minimum of what is necessary to insure favorable conditions, good coöperation, and good effort:

Time of Examination. It is particularly important to study the individual when he is not likely to be in an unfavorable state, physical or emotional. He should be examined when the test results are not complicated by fatigue or hunger. It is obviously unwise to begin testing late in the day or after a long period of waiting, or when the subject has, perhaps, been recently physically ill. We have known of examinations being made in connection with court procedure, for example, after a boy had spent a sleepless night in a police station, or after he had been on a runaway expedition, without a period of rest following it.

Attitude toward Examination. Emotional conditions are of exceedingly great importance in their influence on test results. Yet, in spite of this, they are frequently overlooked, or if noted, not taken into account. It is a matter of primary concern, if reliable findings are desired, to know the emotional attitude of the subject. Emotions may be inhibitory, "blocking" responses. Fear, anger, or indifference may play a very significant rôle in the psychological examination. It is, for example, undesirable to test directly after or immediately before a court hearing, or to begin the testing without changing a bad attitude engendered through being brought under false pretenses for study by parent, teacher, social worker, or probation officer, any one of whom may have given no explanation of the purpose of the examination. The experienced examiner often finds it necessary to make inquiry about the subject's notion of the purpose of the whole procedure. If there has been intelligent management of the situation, the young person may be interested in being tested and feel it a privilege, but unwise adults frequently do not prepare the subject at all or may even give him a reason for the mental examination that is quite prejudicial to awakening interest and favorable attitude. It is absolutely imperative to dispel the notion that the subject is tested because he is thought to be "feeble-minded" or "crazy." It should

be made perfectly clear that the real purpose of the testing is to aid in making for the individual a more sensible plan of life. The educational and vocational implications should be stressed if they are the primary or even incidental reasons for the study.

Underlying or persisting emotional disturbance about one's situation in life may be, and in many cases is, a complicating factor in test results. Indeed, some who accept the psychoanalytic standpoint go so far as to believe that it is repressed emotional conditions that limit capacity, even to the extent of making a normal individual appear defective, and that among the apparently feeble-minded, were these inhibitions removed, intellectual capacities might be found normal. This extreme point of view is very unlikely to be true. Individuals vary so greatly that in their innate abilities they range continuously, following the curve of normal distribution, from the genius to the low-grade feeble-minded. Experimentation has shown that mental capacity is distributed in an unbroken scale. Hence there exist all grades of feeble-mindedness, from the idiot to the high-grade moron and through the border zone of defect. It surely would be acknowledged that the low-grade defective does not suffer so greatly from emotional stress that were he relieved he would be normal mentally. Why then should not high-grade feeble-mindedness exist as innate defect not caused by emotional stress?

But this does not invalidate the fact that any one may be so emotionally disturbed at a particular time that he cannot do himself justice on tests. We have many instances where after retesting when a disturbing situation had cleared up, the earlier test findings were markedly improved.[1]

Place of Examination. If it is at all possible, testing should not be undertaken in a place which bears any stigma. Our experience through retesting has shown repeatedly that some of the results obtained by clinics in institutions for the feeble-minded or in hospitals for the psychopathic and psychotic are unreliable because the subject is humiliated by his surroundings or terrorized by the thought of possible commitment or incarceration. Testing in rooms adjacent to the court or in

[1] For illustrations of various conditions which influence attitudes in examination, *see* Bronner, **3**.

detention homes requires especial care to elicit a favorable attitude on the part of the subject. Preferably, the individual should be examined in a place that lends itself to a professional approach. We have been interested in our own experience in noting the difference between examinations held in official quarters and in an ordinary office building. Very much more favorable is the latter condition. Quiet and freedom from distractions are also essential.

The Examination. 1. Before beginning the testing, the subject's interest must be won. He must be made to feel at ease, to appreciate that the examiner is friendly and interested in him and anxious for him to do his best. The very manner in which the subject is greeted is a matter of consequence. If there is apparent embarrassment, some commonplace conversation may help to overcome this. A brief discussion of his interests or his best abilities may offer a clue to the tests with which to begin the psychological examination. Interest may be further stimulated through motivating the various tests as they are utilized. With young children the game element can be used; with older children one attempts to avoid either of two pitfalls, that of beginning with tests so difficult that discouragement ensues, or so easy that they arouse scorn.

As a rule we do not begin the examination with the giving of the age-level scale, because this involves so largely the questionnaire type of tests. When using the Stanford-Binet scale, we find it of advantage not to give the tests in their serial order, but rather to group them as they lend themselves to similar motivation. Thus, one can give consecutively those tests which deal with similarities and differences (as the eighth of the 12-year series, the third of the 14-year series, etc.), or all those which deal with visualizations.

2. It is essential for the examiner not only to have mastered the general technic of testing, but to be thoroughly familiar with the details of each test that is used. The practice of reading directions and referring constantly in the subject's presence to a book or outline for the directions in giving of tests is unwise, because under such circumstances it is much more difficult to keep the subject's interest and maintain good *rapport*. An examination which is conducted with as little formality as

possible and in which the examiner encourages the subject and stimulates his interest is most likely to bring about responses that are reliable estimates of the individual's best capabilities.

3. As soon as it is apparent that the subject is fatigued or no longer can be stimulated to put forth his best effort, the testing should be stopped. When this point is reached differs with individuals and it is a matter that must be left to the examiner's own discretion.

4. We feel strongly that it is inadvisable ever to have a third person present at an examination. In some clinics a stenographer takes down the individual responses verbatim, but we consider it unfortunate as a clinical practice and ourselves have never found it necessary. Common sense indicates that neither examiner nor subject might be free from embarrassment under such circumstances.

5. For much the same reason it is usually unwise to record in the subject's presence detailed responses to tests or to let him know his record. The supposed accuracy of the scientific scoring thus secured is marred by the fact that under such conditions the record may not present a true picture of the subject's ability.

It is a simple matter to keep very brief though accurate notes and after the test period to construct the record. Scoring should not be done until after the examination; if the subject asks whether his response is correct, the answer, though truthful, should not be made discouraging unless perhaps one feels that there is marked indifference which requires stimulation to greater effort.

6. It is obviously impossible to give directions for every situation that may arise. Tact and common-sense can be trusted to aid in meeting many difficulties. The definite procedure may best be guided by the goal of the examination, namely, the attempt to obtain the individual's best performance. Any method of securing this which does not actually invalidate the purpose of the tests and the accuracy of test results is both legitimate and desirable. Naturalness in giving the tests, genuine interest in the child, avoidance of stereotyped or routine manner — all these are great helps.

In the manual of tests which follows, terse directions are given

for the sake of brevity, but it is always to be understood that the examiner is to introduce such variation as is necessary to stimulate interest. Even such an uninteresting process as testing rote memory-span can be enlivened by telling the subject that it will be interesting to see if he or she would make a good telephone operator. The introduction to the specific tests may, however, be very simple if there is sufficient vivacity on the part of the examiner. It is often quite enough to say, " Can you do this? " when the voice and manner constitute a challenge to the person being tested.

Naturally, too great license cannot be taken. It is obvious that very different results may be obtained with a given test, depending upon the particular way in which the directions are given. On the other hand, it cannot be assumed that the same words will connote the same meaning to every individual. Hence, exact adherence to a formula does not insure uniformity of test conditions.

Granted that all the prerequisites for favorably giving tests have been met, there still remain two very important matters, namely, the selection of the tests to use and the interpretation of the results achieved.

SELECTION OF TESTS

In our everyday work we have found it advisable to have schedules, some briefer, some longer. We adopt as our practical method the plan of giving at the first interview a so-called " minimum schedule ", the purpose of which is to obtain the mental age and intelligence quotient, to see if these are corroborated by other tests, and, more important still, to discover any indication of special abilities and disabilities, using for this last some tests which do not correlate so highly with the intelligence quotient. Always included are some performance tests and tests for motor control, an information test to see how much the individual has benefited by his everyday experiences, and tests of school acquirement.

The schedule used as a minimum by us we give below. We do not imply that it is the most satisfactory that could be devised; in fact we, ourselves, have frequently changed the

tests that are included in it, as other tests have seemed better. We offer it as illustrating our belief that wherever practical problems are to be answered, there must be given at least enough tests to furnish clues to alignment of the individual's different abilities.

Suggested Minimum Schedule

Stanford Revision of Binet-Simon Scale (or Herring or other age-level scale)
Modified Trabue Language Scale
Pictorial Completion Test II
Tapping Test
Ferguson or Worcester Form Boards
Scaled Information Test
Learning Tests Z, B, and D
School Work:

(*a*) Arithmetic — Courtis Fundamentals Test, or testing based on local school curriculum.
(*b*) Spelling and Writing — dictation of passage based on Ayres or Buckingham Scale, or on local curriculum.
(*c*) Oral reading and comprehension based on local curriculum.

Schedule for Testing Defectives

For the testing of those who very speedily are found to be defective or who are sent for examination as possibly defective, certain practical points should be remembered. In the first place, it is frequently necessary to retest such cases, either because of the need of corroboration of findings before advice for commitment is given, or because it is often necessary for a physician or psychologist to reëxamine in order to sign certification papers. Hence tests with alternatives are particularly desirable in these cases.

In deciding that an individual is defective, it is perhaps not necessary to use so wide a range of tests, but nevertheless one wishes more than an intelligence quotient, except perhaps for those so low grade that they rank as imbeciles or low-grade morons. For other defectives, we feel it advisable to supplement the ordinary age-level scale by tests for common-sense information, although these latter should not so much follow a stand-

ardized scale as cover points to make clear whether the individual has learned normally from his daily experiences. For example, in place of the historical and geographical information in the standardized series, we utilize questions concerning the telling of time and making of simple change, knowing the streets in the individual's neighborhood, and how one would get from home to school, facts about the local and national holidays, etc. We, ourselves, test defectives briefly in four fields, namely: (1) intelligence quotient or mental age; (2) motor control and ability with concrete material; (3) acquirement of school knowledge; (4) common-sense information.

Because of the help in deciding questions of practical adjustment, we believe that there is a very great field for the study of special abilities among defectives and that tests for determination of such abilities should be given in cases not likely to be sent to institutions for defectives. In the latter cases, it is likely that the institutions themselves will give tests looking towards help in educational and vocational matters. Questions concerning educational and industrial prognosis, even for the defective, can best be answered through the use of a wide range of tests.

Longer Schedules

We need hardly illustrate completely the schedules to be used in all the more complex problems that may present themselves to the clinical psychologist. Such problems group themselves roughly under the headings (*a*) determination of special abilities or disabilities; (*b*) indications of psychotic trends, (*c*) determination of candidates for so-called "opportunity classes", namely, the all-round gifted; (*d*) advice for those entering high school, looking toward deciding the course of study to be pursued; (*e*) general vocational guidance; (*f*) highly specialized problems, such as defect for reading or number work. Just what tests shall be utilized varies from case to case, depending on the problem, on the age of the individual who is being studied, and on the practical exigencies of the situation. We illustrate here only sufficiently to show the method which we follow.

Schedule for Study of Visual Mental Representation
(as distinguished from visual memory)

Cross-line I; Cross-line II; Code
Hands Test
Floor Plan
Geometrical Objects
Imaged Cube Test
Inverted Figures
Land Section Test

(Some of the tests in the Stanford-Binet, interpreted qualitatively, belong here; besides the Code, these include Clock Hands, Enclosed Boxes, Paper Tearing Tests.)

Schedule for Special Study of Mental Control or Attentional Difficulties

Easy Opposites Test
Genus-Species
Mixed Relations
Part-Whole
Free Association (Kent-Rosanoff)
Constant Increment
Continuous Subtraction

(In this connection come the findings on the Digits Backwards Test, Spelling Backwards, and other tests in the Kuhlmann Revision of the Binet-Simon Scale.[1])

It seems unnecessary to outline schedules for study of language ability or of ability to deal with ideational material since the grouping of tests in this book constitutes a guide for such study and the same is true of intensive study of memory and learning powers and of ability to deal with concrete material, tests for the latter being given under the headings, Mechanical and Assembly Tests, and Form Board and Construction Board Tests. The norms will prove of great value in deciding the ages at which any test is significant and for which it is suitable.

The ideal procedure is, whenever possible, to study the individual by means of a very wide range of tests on the basis of

[1] See Plant, 252.

which one could compare success along various lines. Indeed, it is only by such intensive — or extensive — study that one is able to answer some of the problems enumerated above, particularly those under (*a*), (*d*), (*e*), and (*f*). Such testing, it is true, requires, in the case of those who work at about average speed, some six to eight hours, spread over three or four interviews. While such an amount of time may seem to some excessive, still, when one considers the importance of gaining as much insight as possible into the various mental capacities, in order to base thereon practical and highly significant procedure, it does not seem at all unwarranted; neither is it, we have found, impractical. Indeed, where specific vocational and educational advice is sought by schools, charitable agencies, or families, we regularly follow this plan. Certainly the consequences dependent on recommendations made are so important that six to eight hours seem in comparison a very small amount of time expended in obtaining knowledge that is a solid foundation upon which to build.

INTERPRETATIONS

More difficult than the giving and the scoring of mental tests is the matter of interpretation. Experimentation has not yet developed to the point of having proved just what mental abilities are tapped by any one test. Yet certain conclusions are valid, as, for example, that some tests are properly called performance tests; that all these deal with ability to work with concrete material; that such abilities vary from those which require largely perception of form to those involving mechanical skill and dexterity. Even if the mental powers involved in any one test are not definitely known, yet by using several it is possible to reach a general conclusion concerning whether the individual has ability to deal with objects.

And the same is true of other groups of tests. One may not be able to say that any one test involves only powers of visualizations, let us say. Thus, it may be that the Reverse Clock Hands Test (Stanford-Binet, fourteen years) is largely solved by some individuals through visualizations or mental representations. But another individual may solve the test without the

use of visual imagery and altogether by reasoning. Granted that this is so, it still seems valid practically to conclude that if a whole group of tests, each most frequently utilizing visualizations in their solution, is given, the common feature — *i.e.*, visualization — will stand out as being good or poor, even though no one of the tests in the series may be decisively indicative of any one special ability.

This same principle would hold good for any other series of tests all having some one feature in common. Thus, one might have a series in which the language element was particularly prominent, or in which auditory memory was stressed, or in which reasoning or generalizations, dealing with abstractions, was the prominent feature.

In spite of limited exact knowledge, then, our practical experience leads us to believe that out of the many tests now available, it is possible so to group tests that certain abilities and disabilities can be more or less safely determined. While no test is probably a reliable measure of any one ability, yet by utilizing a group of tests involving an identical mental ability, a fair estimate of that ability may be made, leaving aside for the time being whatever other powers are called into play.

It is very likely that involved in all tests are certain mental factors, such as attention, persistence, and to some extent mental control, though these are themselves particularly emphasized and evaluated by a certain number of psychological tests. But because they are so generally a feature in the entire test performance and condition the validity of the findings, we make it a part of our ordinary test procedure to estimate them and to preface all statements of test results by what we designate as "psychological impressions." This gives the experimenter's estimate of the reliability of the test findings as a whole or for the different tests used; it also offers the chance for recording personality traits that are observed.

Parenthetically, we may here state that the test period offers an opportunity for noting many interesting attitudes and personality traits, the reliability of judgment, naturally, depending upon the training and keenness of observation of the experimenter. Watching the behavior of one individual after another in the same situation — *i.e.*, observing the reactions to

the psychological tests — one soon becomes aware of varying methods of attacking problems and varying personal characteristics. Always to be noted is the amount of interest or response elicited, the degree to which there is enjoyment of mental tasks, and the extent to which there is desire to know the purpose of either testing as a whole or of the individual tests. Then, some are very slow and deliberate workers, others are quick and impulsive; there is variation in fatigueability, in the extent to which the individual is disturbed by failure and pleased by success or praise. Lack of confidence or overconfidence as well as the degree of self-criticism may also be recognized; other personal peculiarities, too, are often revealed during the testing.

Our interpretations of the various individual tests are indicated in this manual by the headings under which the tests are arranged in Part II and by specific statements concerning their interpretation in Part III. It will be seen that aside from the incidental mental processes mentioned above, we believe that some tests deal specifically with memory powers, others with ability to deal with concrete and mechanical material, still others stress motor control as distinguished from general manual dexterity, some are concerned with rote as opposed to ideational powers, etc.

For tests which have been adequately standardized, it is a simple matter to evaluate results in terms of norms, though there still remains the question of so interpreting the findings as to make them have meaning for practical applications. Unstandardized or inadequately standardized tests cannot be satisfactorily dealt with from the point of view of age or grade performance, but very frequently they are useful descriptively, and, after a certain amount of experience with them, a performance can be translated into three or five degrees of excellence. Very seldom is there a question concerning extremes of achievement; one readily comes to know whether a result is very good or very poor. More difficult, perhaps, is the judgment concerning the mid-point or average performance. In our own procedure now, after having had years of experience with testing young people, we find it practicable to use a fivefold classification.

Five-Column Grouping of Test Findings

When one deals after the above-mentioned fashion with test results, standardized or unstandardized, there develops what might properly be called a psychograph. Grouping together the very good results, the good, average, poor, very poor (should the range of results be so great), one obtains a picture that often clearly demonstrates the individual's strong and weak points in mental capacities and that sometimes can be translated into a more or less accurate graph. Then may come discussion of the findings for recommendations. The use of this method we illustrate below from an actual case study where a moderate amount of testing was done.

JOHN DOE

Chronological Age, 13 years, 9 months

Very Poor	Poor	Average	Good	Very Good
Rote Auditory Memory (*Digits Span*)	Vocabulary (*Stanford-Binet*)	Intelligence Quotient 99; Mental Age 13 7/12 years. (*Stanford-Binet*)	Learning Ideas (*Learning D*)	Visual Memory (*Ellis Figures*)
Auditory Memory for Ideas (*Whipple Sentences*)	Language Apperceptions (*Modified Trabue*)	Spelling (*Ayres Scale*)	Information (*Scaled Information*)	Visual Rote Learning (*Learning Z*)
	Following Directions (*Pintner-Toops*)	Oral Reading (*Curriculum Basis*)	Generalizing (*Equivalent Proverbs*)	Visualizing (*Clock hands*) (*Enclosed Boxes*) (*Code*) (*Paper Tearing*) (*Inverted Figures*) (*Floor Plan*)
	Apperceptions (*Pictorial Completion II*)	Silent Reading (*Kansas Silent Reading*)	Arithmetic (*Courtis*)	Mechanical Skill (*Stenquist Assembly*) Concrete Perceptions (*Ferguson Boards*) Motor Control (*Tapping*)

The outstanding features of the above chart are, first, the great range of the results and, second, the manner in which the test findings group themselves. The most marked contrast is found between auditory and visual powers; less extreme, yet sharply defined, is the difference between ability with lan-

guage and ability with concrete material. Visual memory for form, powers of associating or learning rote visual material, visual imagery or visual mental representation, all these are exceptionally good, whereas auditory memory both for rote and non-rote is correspondingly weak. Very good motor control, dexterity, and ability to solve problems with concrete material also stand out as distinct assets, while knowledge and use of language are correspondingly poor. Upon these findings may be based very practical advice concerning methods of study as well as methods of teaching and guidance for further course of study to be pursued or vocation to be sought. Draftsmanship, carpentry or shop work would seem likely to offer more chances for success than linguistics, or, let us say, salesmanship.

If John Doe is physically well and has desirable personality traits, and is not seriously handicapped by personal or family problems, he should be able to succeed in high school, choosing mechanical or practical arts course in preference to the classical or college preparatory courses.

PART TWO

THE INDIVIDUAL TESTS

Foreword

Part Two has been planned to include every adequately standardized individual mental test. We have considered "adequate" only those averages and medians based on a minimum of fifty cases. This line of division is purely arbitrary and it is true that mere addition of numbers does not necessarily increase validity. We are convinced, however, that a smaller sampling of the population would have very little significance. Insisting upon even this minimum, we have found, however, no less than thirty tests, which, though used and apparently worthwhile, are inadequately standardized. These constitute Chapter 8. They offer a basis for research for many years to come.

We have taken the liberty of so modifying tables as to include, for the most part, only those norms based on at least fifty cases at each age. Where this rule has not been observed, the numbers are in italics.

The title of each test refers, with a very few exceptions, to the material employed. The name of the original author or authors has uniformly been placed to the right of the title. The process of identifying each test and separating the various modifications has proved so laborious that we suggest that in the future all test material should be marked with its title, the name of the author, and the date of publication. Norms are applicable only when the material and methods with which they were established are used.

The tests have been grouped into five categories, each of which is dealt with in a separate chapter. We wish it to be clearly understood that these divisions are purely arbitrary, necessarily overlap, and we give them without interpreting them as having reference to any distinct functions or faculties of the mind.

As usual in psychological literature, E stands as the symbol for examiner and S for subject.

In this section, and throughout the book, numbers in boldfaced type are references to the bibliography.

CHAPTER 3

Language and Ideational Tests

1. Arithmetical Series
2. Cause and Effect
3. Coal Passage Imagination
4. Crossline II
5. Essential Differences
6. Free Association — Discrete
7. Genus-Species
8. Hands
9. Ingenuity
10. Language Completion Scales (Trabue)
11. Language Completion (Kelley-Trabue)
12. Language Completion (Trabue-Kelley-Spivak)
13. Narrative Pictures
14. Opposites
15. Opposites (Burt)
16. Opposites (King-Gold)
17. Opposites — Hard (Means)
18. Opposites (Woodworth-Wells)
19. Part-Whole
20. Pictorial Completion I
21. Pictorial Completion II
22. Proverbs
23. Range of Information
24. Revised Directions
25. Scaled Information
26. Sentence Vocabulary
27. Silent Reading (Burgess)
28. Silent Reading (Monroe)
29. Silent Reading (Thorndike-McCall)
30. Syllogisms
31. Word Building (Whipple)

For unstandardized tests belonging to this category, see Tests 98, 99, 100, 101, 103, 104, 106, 108, 110, 111, 113, 114, 116, 117, 118, 120, 122, 126.

1. ARITHMETICAL SERIES TEST — SHAKOW-KENT

Material: Series of numbers as below:

Samples:	1 16	2 14	3 12	4 10	5 8	6 6	7 4	8 2
a	2	4	6	8	10	12	——	——
b	1	3	5	7	9	11	——	——
c	10	9	8	7	6	5	——	——
d	90	80	70	60	50	40	——	——
e	5	15	25	35	45	55	——	——
f	11	22	33	44	55	66	——	——
g	13	17	21	25	29	33	——	——
h	3	4	6	9	13	18	——	——
i	45	40	35	30	25	20	——	——
j	1	1	2	2	3	3	——	——
k	4	9	14	19	24	29	——	——
l	9	11	13	10	12	14	——	——
m	8	6	7	5	6	4	——	——

Directions: S is told to find out how numbers are made up in each row and then to write the *two* numbers which come next.

Scoring: Final score is number of lines correctly completed.

Norms:[1] 700 cases. (Shakow, Kent)

Age	8	9	10	11	12	13	14	14+
Average (smoothed)	5	6	7	8	9	10	12	13

[1] From letter to authors.

2. CAUSE AND EFFECT TEST — WOOLLEY [1]

Material: [2] Paper and pencil. Following list of words for E.

First Reading		*Second Reading*
1. hunger	faintness	1. the government
2. melting snows	floods	2. debt
3. nourishment	strength	3. death
4. the government	protection	4. hunger
5. dirt	disease	5. work
6. effort	achievement	6. a wound
7. death	sorrow	7. melting snows
8. exercise	fatigue	8. cold
9. cold	ice	9. practice
10. a wound	pain	10. effort
11. beauty	admiration	11. nourishment
12. debt	trouble	12. sin
13. practice	skill	13. dirt
14. sin	punishment	14. exercise
15. work	wages	15. beauty

Directions: E explains what is meant by cause and effect by illustrating with *storm — shipwreck; tree — shade.* S is told that E is going to read some pairs of words in which the first word is the cause and the second the effect, and that after the list is completed E will read, in changed order, the first word of each pair and S is to write the second. If he cannot think of the effect given in the reading he is to write another equally good. He is to signify by a mark the omission of a word. After these directions E reads the pairs of words, allowing five seconds between pairs. Then, following the order of the second reading, S writes the second word.

Scoring: [3] Score two credits for an entirely correct association, whether in the original list or not; score one credit for every partially correct association. Change scores into percentages, dividing number correct by thirty.

Norms: [4] 606 Males. 534 Females. (Woolley)

PER CENT CORRECT FOR SIXTEEN-YEAR MALES AND FEMALES

Sex	75 percentile	50 percentile	25 percentile
M	97.0	87.3	71.4
F	100.0	89.0	73.4

[1] 100, pp. 131–138. [2] For alternate list, *ibid.*, p. 132.

[3] For exact list of credits, *ibid.*, pp. 134–137.

[4] For fuller norms, *ibid.*, p. 133.

3. COAL PASSAGE IMAGINATION TEST

Material:[1] Paper at the top of which are written the following paragraphs:

Suppose the coal supply of the United States should come to a sudden end, what changes might occur?
Allow your imagination full swing and write as many and as detailed suggestions as you can in five minutes.

Directions: As above.

Scoring:[2] For quantitative score record the number of different ideas, no matter how expressed. For qualitative judgment compare each idea with frequency table, the degree of originality being in inverse proportion to frequency.

Norms:[3] 1000 cases. (Shimberg-Lowe)

Quantitative Norms: No age or sex differences were found to obtain from 12 years to the adult level. Percentile ratings are as follows:

Percentiles	*Scores*
100	13
90	8
80	7
70	6
60	5
50	5
40	4
30	4
20	3
10	2
0	0

Qualitative judgments may be made from the table below. For convenience, responses have been roughly classified and arranged alphabetically under these classifications. Numbers signify frequency of given response.

Frequency Table

I. Influence on Everyday Life

A. Immediate results

108 Boats not running
95 Buildings not heated
49 Couldn't cook
275 Factories not running
272 Freezing

[1] For a similar test of Economic Prophecies *see* Chassell, **128**, pp. 321–322.
[2] Up to date no satisfactory method of combining quantitative and qualitative scores has been found.
[3] Judge Baker Foundation study as yet unpublished.

202 Higher cost of living
59 Schools closed
13 Substitute warm clothing
258 Trains not running

B. Ultimate results

11 Adapt to changed environment
8 Bodily adjustment to lower temperature
17 Crime wave
25 Decrease food supply; no transportation
122 Deprivation
134 Famine
7 Profiteering
87 Riot
32 Sickness
11 Strike

II. Influence on the Nation

A. On Commerce and Industry

54 Business paralyzed
56 Change in industry
9 Change location industry
96 Coal-driven apparatus useless
22 Coal mines shut up
10 Communication cut off
73 Decreased products
85 Electrical equipment paralyzed
36 Electrical transportation increased
18 Government regulation
237 Importation
41 Increase in methods of transportation
96 No coal by-products

B. On Labor

38 Changes in occupation
133 Coal miners out of work
13 Labor in demand
199 General unemployment

C. On Natural Resources

134 Destruction of forests
32 Increased value of natural resources
7 Spoil natural beauty
70 Use of trees for wood

D. On Population

15 Extinction population U. S.
8 Degeneration U. S.
31 Migration to other localities
34 Migration to warm districts
14 New history of America

E. On Science and Invention

56 Change in running boats
99 Change in running factories
50 Change in running trains
5 Chemical inventions
19 Development electricity
149 Other new inventions
5 Radio usage
5 Reconstruct machinery

F. On Wealth

8 Change distribution of wealth
29 U. S. impoverished

III. Influence on World

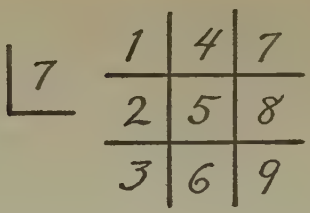
13 Affect entire world
45 Foreign trade cease
2 Little immigration
24 Weakening of U. S.

IV. Use of Substitutes for Heat

26 Coke, cinders, refuse
229 Combustible liquids
138 Electricity for heat
145 Gas
27 Peat
107 Reconstruction heating apparatus
480 Wood

V. Use of Substitutes for Power

2 Electricity from storms
88 Electric power
11 Special devices water-power
5 Sun's rays
2 Volcanoes, etc.
123 Water power in general



4. CROSSLINE II TEST — HEALY [1]

Material: Paper and pencil.

Directions: [2] E draws the above figure and fills in the numbers with the paper and figure squarely before S. Then, with the figure still in plain view, emphasize sequence of numbers by tracing lines of each separate space and saying, "You see, number one goes in here," etc. Then draw space 7, and ask what number belongs in it. After correct answer has been given conceal the figure and draw the spaces in irregular order, beginning with 7 followed by 5, then in random order. As each space is drawn, S is asked what number belongs in it. Ask S if there are any errors and allow him to make his own corrections. Give four trials if necessary, telling S in second, third, and fourth trials to draw the figure and put numbers in place. In each trial draw spaces in random order, asking S to tell the number that belongs to each.

Scoring: Score is trial at which all spaces are numbered correctly. Record as failure if there are errors in the fourth trial.[3]

Norms: [4] 1225 cases. (Haseltine, Lowe, Shimberg)

Median Score	Age
3	9–10
2	11
1	12–17

[1] Healy, Fernald, 49, pp. 30-32.

[2] For a different method of giving this test *see* Schmitt, 91, pp. 106–108.

[3] We would suggest that in the future, for finer discrimination of scores, the final score should be the sum of the correct figures on each trial plus 9 for each trial not given (*i.e.*, in cases of success at an earlier trial).

[4] Judge Baker Foundation study as yet unpublished.

5. ESSENTIAL DIFFERENCES TEST — SHAKOW-KENT

Material: Printed blank containing twenty-six groups of four words each as below.

Samples:

apple	carrot	peach	pear
bitter	sour	sweet	white

1	breakfast	dinner	grapefruit	supper
2	bedroom	kitchen	parlor	stage
3	geography	reading	school	spelling
4	camera	flute	piano	violin
5	cow	dog	sheep	tiger
6	box	drawer	field	room
7	Lincoln	Pershing	Washington	Wilson
8	beer	grape juice	lemonade	orangeade
9	bread	candy	meat	potatoes
10	boots	shoes	slippers	stockings
11	island	lake	river	sea
12	hop	jump	skip	walk
13	long	loud	short	tall
14	mole	rabbit	rat	worm
15	book	letter	magazine	newspaper
16	bricks	concrete	shingles	window
17	cry	shout	whisper	yell
18	bench	chair	sofa	table
19	bag	basket	handle	valise
20	recline	rest	sleep	work
21	duck	goose	hen	swan
22	chimney	fire	smokestack	stovepipe
23	canary	lark	oriole	robin
24	coal	paper	steel	wood
25	Boston	Florida	Maine	Ohio
26	forest	grove	tree	woods

Directions: S is to mark the *one word* in each line which does not belong there.

Scoring: Final score is number correctly marked.

Norms:[1] 700 cases. (Shakow, Kent)

Age	8	9	10	11	12	13	14	14+
Average (smoothed)	9 or 10	11 or 12	13 or 14	15 or 16	17 or 18	19 or 20	21 or 22	23 and over

[1] From letter to authors.

6. FREE ASSOCIATION TEST — KENT-ROSANOFF [1]

Material: List of one hundred stimulus words [2] as below:

table	wish	stem	bitter
dark	river	lamp	hammer
music	white	dream	thirsty
sickness	beautiful	yellow	city
man	window	bread	square
deep	rough	justice	butter
soft	citizen	boy	doctor
eating	foot	light	loud
mountain	spider	health	thief
house	needle	bible	lion
black	red	memory	joy
mutton	sleep	sheep	bed
comfort	anger	bath	heavy
hand	carpet	cottage	tobacco
short	girl	swift	baby
fruit	high	blue	moon
butterfly	working	hungry	scissors
smooth	sour	priest	quiet
command	earth	ocean	green
chair	trouble	head	salt
sweet	soldier	stove	street
whistle	cabbage	long	king
woman	hard	religion	cheese
cold	eagle	whiskey	blossom
slow	stomach	child	afraid

Directions: Ask S to say (or write) the first word he thinks of when he hears the stimulus word.

Scoring and Norms are in the form of a frequency table which must be consulted by E.[3]

[1] **162.**

[2] A series of 1000 words intended for general use is given by Woodworth, Wells, **170**, pp. 81–85.

[3] For adult responses *see* Kent, Rosanoff, **162**; for children's responses *see* Woodrow, Lowell, **169.**

7. GENUS–SPECIES TEST — PYLE [1]

Material: Printed slip containing the following twenty words:

mountain	ocean
city	fruit
wood	country
metal	animal
furniture	bird
machine	food
author	lake
planet	tool
river	fish
book	money

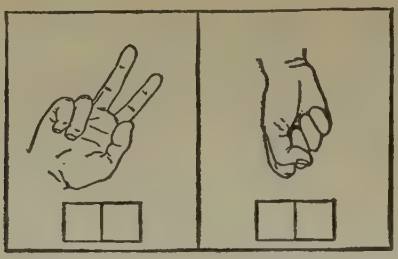
Directions: Tell S that each of the words before him is a class name. After each one he is to write an example of that class. Illustrate with *food — bread, clothing — coat.*[2]

Scoring: Time limit for entire test sixty seconds for Grades 2, 3 and 4; forty-five seconds for higher grades. Allow one point for each correct word written.

Norms:[3] 461 Males — 498 Females. (Pyle)

Sex	Age	9	10	11	12	13	14	Adult
M	Average	5.7	6.5	7.2	7.1	10.0	10.5	15.1
	A. D.	3.4	3.7	3.3	2.5	3.8	3.8	4.0
F	Average	5.4	7.8	8.2	9.3	9.5	11.8	15.5
	A. D.	2.5	3.2	3.7	2.9	3.2	3.2	3.8

[1] 58, pp. 29–31. [2] *Ibid.*, p. 29. [3] For fuller norms *ibid.*, p. 30.



8. HANDS TEST — THURSTONE

Material: Forty-nine drawings of right and left hands in different positions, as illustrated above.

Directions: S is instructed to indicate whether each separate drawing represents a right or left hand.

Scoring: No time limit. Final score is total number correct.

Norms: *a*) 238 College Students — Male (Engineering School) (Thurstone [1])

b) 114 College Students — Female (Practical Arts) (Thurstone [1])

Percentiles	*Scores*	
	a	*b*
100	49	48
90	49	35
80	49	29
70	45	24
60	38	21
50	33	18
40	29	16
30	25	14
20	21	12
10	14	9
0	10	3

[1] From letter to authors.

9. INGENUITY TEST — GWINN-THURSTONE

Material: Printed form stating twenty-five problems of greatly varying difficulty, *e.g.:*

(*a*) Seventeen matches are laid on the table so as to form six equal squares as shown by the lines in the drawing above. Cross out six lines to show which six matches you would take away to leave two squares only. No extra matches are to remain.

(*b*) A invests $10,000 and B $5000. They buy three houses of equal value. Each one takes a house for himself and they sell the remaining house for $12,000. How should the money be divided?

Directions, Scoring, and Norms in manual which is supplied with material.

10. LANGUAGE COMPLETION SCALES — TRABUE [1]

Material: [2] Nine printed forms of ten sentences each (four sets of sentences more difficult than the other five), with words elided, one word represented by each blank space, *e.g.:*

The boy has —— book.

Birds have —— which enable them to —— through the ——.

Directions and **Scoring** in booklet which is a necessary part of the material.

Norms: [3] (Trabue)

MEDIAN SCORES BY GRADE FOR SCALES B, C, D, OR E

Grade	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Median	4.8	8.0	10.0	11.4	12.4	13.4	14.4	15.2	16.0	16.7	17.4

[1] **120.**

[2] This kind of test is a modification of the Ebbinghaus Mutilated Text Test. Ebbinghaus, **106**, pp. 401–459. For norms with an English paragraph for 17 and 18-year-olds, *see* Woolley, **100**, pp. 105–110.

[3] **121**, p. 58.

11. LANGUAGE COMPLETION TEST [1] — KELLEY-TRABUE

Material: Two equivalent series of forty sentences each with words elided, sentences arranged in order of difficulty. For illustration, *see* Test 10.

Directions and **Scoring** given in booklet which is necessary part of material.

Norms: [2] (tentative) (Kelley)

Age	7	8	9	10	11	12	13	14	15	16	17	18
Average	1.1	1.9	3.1	5.0	6.2	6.7	7.1	7.3	7.6	8.2	8.7	9.0

Grade	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	College Graduate
Norm	2.2	3.7	6.0	6.7	7.1	7.4	7.8	8.5	8.9	9.3	9.5	11.4

[1] Kelley, **109**, pp. 371–382.
[2] *Ibid.*, p. 381.

12. LANGUAGE COMPLETION TEST — TRABUE-KELLEY-SPIVAK

Material: Twenty sentences arranged in order of difficulty,[1] as below:

1. We are going —— school.
2. The sky —— blue.
3. The —— is barking at the cat.
4. Men —— older than boys.
5. The stars and the —— will shine tonight.
6. The bird —— a song every morning.
7. Boys must —— be rude to —— mothers.
8. The girl fell and —— her head.
9. When the —— grows older he —— be a man.
10. The poor baby —— as if it were —— sick.
11. Hot weather comes in the —— and —— weather —— the winter.
12. She —— if she will.
13. The boys who play —— —— mud get their hands ——.
14. Brothers and sisters —— always —— to help each other and should —— quarrel.
15. Many people —— their health because —— do not —— the —— of hygiene.
16. A shelter —— the weather is —— appreciated on a —— day.
17. To —— many things —— ever finishing any of them —— a —— habit.
18. Extremely old —— sometimes —— almost as —— care as ——.
19. The knowledge of —— —— use fire is —— of —— important things known by —— but unknown —— animals.
20. In order —— —— clearly at —— it is —— to —— artificial ——.

Directions and Scoring in booklet which is a necessary part of the material.

Norms:[2] (*a*) 865 cases. (*b*) 919 cases. (Shimberg, Lowe, Meehan)

(*a*)

Age	7	8	9	10	11	12	13	14	15	16	17	18
Av. Score	*7.7*	16.1	17.3	19.8	24.4	25.1	26.7	28.6	30.9	31.3	33.0	32.7
S. D.	*5.2*	5.5	5.4	6.4	7.9	4.7	4.7	4.9	4.6	4.6	4.4	4.5

(*b*)

Grade	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Av. Score	8.9	17.0	*19.5*	20.4	25.6	25.8	27.9	29.4	32.4	32.3	33.3
S. D.	5.3	5.6	*5.6*	4.1	6.0	4.4	4.4	4.5	4.5	4.1	4.0

[1] With the permission of Trabue the original sentences and scaling were retained in making this revision.

[2] Judge Baker Foundation study as yet unpublished.

13. NARRATIVE PICTURES TEST — HAYES-DEWEY [1]

Material: Cinderella "Stampkraft" book [2] and, pasted on a sheet of cardboard, the twelve picture posters [3] accompanying the story.

Directions: Place pictures before S and tell him that you are going to read him a story about the pictures and he is to pick out the one that goes with each part of the story. E reads the story, stopping at each of the marked places and waits for S to tell which is the correct illustration. Note whether S knows the story of Cinderella or has seen the pictures.[4]

Scoring. Time limit one minute for each picture. Credit ten points for each correct choice. Note time for each response taking more than ten seconds.

Norms: [5] 500 Jewish cases. (Dewey, Child, Ruml)

Sex	Age	9	10	11	12	13
M	Average	48.3	51.8	56.2	64.8	65.9
	S. D.	19.1	19.3	21.0	19.7	15.8
F	Average	56.8	57.9	64.5	62.5	72.4
	S. D.	17.6	23.0	15.4	19.2	20.3

[1] Dewey, Child, Ruml, **44**, pp. 23–30.
[2] Book published by Barse and Hopkins, New York. For revision, *see* **44**, pp. 24–28.
[3] Order of pictures, **44**.
[4] *Ibid.*, pp. 28–29.
[5] For fuller norms, *ibid.*, p. 79.

14. OPPOSITES TEST [1]

Material: List as follows:

1. good	6. loud	11. like	16. empty
2. outside	7. white	12. rich	17. war
3. quick	8. light	13. sick	18. many
4. tall	9. happy	14. glad	19. above
5. big	10. false	15. thin	20. friend

Directions: Illustrate the meaning of opposite by having S give correct opposites for *long, up, soft, north.* Then tell S to write the exact opposite of each word in the list.

Scoring: Time limit for entire list sixty seconds. The score is number correct. Any word that could possibly be considered as an opposite is allowed. Adverbs or nouns not allowed for adjectives, or adjectives for nouns.[2]

Norms: [3] 3452 cases. (Pintner)

Age	6	7	8	9	10	11	12	13	14	15	16	Ad.
80 percentile	0	5	7	9	12	13	16	17	18	18	19	20
Median	0	2	4	7	8	10	12	14	15	15	15	20
20 percentile	0	0	1	3	5	6	8	10	12	12	11	19

[1] *See* Pintner, **56**, pp. 23, 88–89.
[2] For fuller discussion of scoring, *ibid.*, pp. 96–97.
[3] For fuller norms, *ibid.*, p. 35.

15. OPPOSITES TEST — BURT [1]

Material: Fifty words as follows:

Old	Warm
Poor	Tight
Big	Mountain
Early	Father
Long	True
Easy	Shut
Inside	Female
Pretty	Few
Boy	Heavy
Wet	Multiply
Kind	Absent
Winter	Moving
Woman	Question
Slow	Now
White	Polite
Upwards	East
Loud	Enemy
Crooked	Nobody
Cheap	Glad
Busy	Top
Sunrise	Possible
Brother	Come
Borrow	Front
Clean	Day
Common	Tame

Directions: Say to S, "Against every word write another which means the opposite of the printed word."

Scoring: Time limit five minutes. Score is number correct.

Norms: [2] 800 English cases. (Burt)

Age	8	9	10	11	12	13	14
Average Score	10.2	18.5	29.4	35.8	39.3	42.6	45.2

[1] **43**, pp. 222–226.
[2] *Ibid.*, p. 222.

16. OPPOSITES TEST [1] — KING-GOLD

Material: [2] Parallel graded lists of words, as follows:

List I		*List II*	
yes	push	rich	broad
in	much	young	increase
new	tender	east	strength
north	false	empty	generous
heavy	rude	dead	like
sharp	stormy	sour	part
weak	bless	wild	silly
love	frequently	less	refined
best	injurious	buy	permit
over	strict	friend	simple

Directions: Instruct S to write exact opposite after each word. Illustrate procedure with *cold* and *little.*

Scoring: [3] Time limit ninety seconds. Final score is sum of full credit and half credit responses.[4]

Norms: [5] 2325 cases. (Arthur)

	Age	6	7	8	9	10	11	12	13	14	15	16	17
List I	Average	.04	1.11	2.83	4.27	6.11	7.25	8.51	10.62	11.07	11.87	13.13	13.81
	S. D.	.31	1.74	2.45	2.97	3.09	3.35	3.32	3.20	3.28	3.48	3.02	2.84
List II	Average	.05	1.29	3.45	4.79	6.47	7.54	8.58	10.23	10.93	12.27	13.72	14.92
	S. D.	.37	2.0	2.74	2.71	2.49	2.41	2.74	2.76	3.21	3.26	2.26	2.61

[1] **163**, pp. 459–482.

[2] Arthur, **158**, pp. 483–495.

[3] In Arthur's standardization, responses were scored according to decision of ten judges. Specific details are not given. A frequency table for adults' responses, with appropriate credits, is given by King, Gold, **163**, pp. 469–482.

[4] For a less arbitrary method of scoring, points should be assigned according to values worked out by Arthur, **158**, pp. 492–493.

[5] For fuller norms, *ibid.*, p. 495.

17. (HARD) OPPOSITES TEST. — MEANS [1]

Material: [2] Printed list of the following words:

1. Full	18. Hinder	35. Defective	52. Permit
2. Negative	19. Despondent	36. Stingy	53. Orthodoxy
3. After	20. Vague	37. Reveal	54. Analytical
4. Dim	21. Fertile	38. Diligent	55. Extrinsic
5. Blunt	22. Doubtful	39. Join	56. Sacred
6. Success	23. Injurious	40. Impoverish	57. Dynamic
7. Pessimistic	24. Busy	41. Permanent	58. Loquacious
8. Joy	25. Abstract	42. Elation	59. Heterogeneous
9. Public	26. Advance	43. Sinful	60. Spurious
10. Profit	27. Foreign	44. Obnoxious	61. Disastrous
11. Spend	28. Create	45. Conservative	62. Facility
12. Always	29. Simple	46. Victorious	63. Pride
13. Graceful	30. Extravagant	47. Obscure	64. Result
14. Strength	31. Aristocratic	48. Proficient	65. Adroit
15. Ancient	32. Rare	49. Rigid	66. Parsimony
16. Expand	33. Dangerous	50. Repulsion	67. Suave
17. Barbarous	34. Slovenly	51. Imaginary	68. Exoteric

Directions: S is told to write beside each word its exact opposite as quickly as he can. E illustrates with *black*. Explain that the opposite must be the same part of speech as word in list and must not be formed by prefixing *non* to the given word.

Scoring: Time limit six minutes. Allow full credit for exact opposite and half credit for approximate opposite.[3] Credits are in terms of point values as follows:

Words	1–8	9–14	15–21	22–33	34–39	40	41–47	48–50
Credit	1	2	3	4	5	6	7	8

Words	51–53	54–55	56–58	59–60	61	62–63	64–65	66	67	68
Credit	9	10	11	12	13	14	15	17	22	26

Norms: [4] 1628 college students. (Means)

	Freshmen	*Sophomores*	*Juniors*	*Seniors*	*Graduates*
75 Percentile	139.0	165.5	192.0	173.0	213.0
Median	107.0	125.0	146.0	137.5	155.5
25 Percentile	82.5	92.5	106.0	108.0	136.0

[1] 164.

[2] For three other lists of hard opposites with adequate norms on 17 and 18-year-olds *see* Woolley, 100, pp. 111–130.

[3] For exact credits allowed for each response, *ibid.*, pp. 28–32.

[4] For fuller norms, *ibid.*, pp. 51–56.

18. OPPOSITES TEST — WOODWORTH-WELLS [1]

Material: [2] A list of twenty words as follows:

1. long	6. smooth	11. lost	16. day
2. soft	7. early	12. wet	17. yes
3. white	8. dead	13. high	18. wrong
4. far	9. hot	14. dirty	19. empty
5. up	10. asleep	15. east	20. top

Directions: Say, "I am going to see how quickly you can think. I'll say a word and you say the opposite as quickly as you can." Illustrate with *boy — girl, pretty — ugly.* Give words orally.

Scoring: Record errors (wrong responses) and failures (lack of response within ten seconds.) Time score is average of correct responses in fifths of a second.

Norms: [3] 1498 cases. (Hazeltine, Lowe, Shimberg)

Age	9	10	11	12	13	14	15	16	17
Time Range of Middle 50%	1.9 to 2.9	1.7 to 2.6	1.7 to 2.4	1.7 to 2.1	1.5 to 2	1.4 to 1.8	1.3 to 1.7	1.2 to 1.6	1.1 to 1.5
Error Range of Middle 50%		1 to 3	1 to 3	0 to 2	0 to 2	0 to 1	0 to 1	0 to 1	0 to 0

For twelve years and below one failure is within the limits of normality.

[1] 170, pp. 59–60, 64–67.

[2] For eight additional sets of *easy opposites* with adequate norms for 14, 15, and 18-year-olds *see* Woolley, 100, pp. 111–130.

[3] Judge Baker Foundation study as yet unpublished.

19. PART-WHOLE TEST — PYLE [1]

Material: Printed slip containing following twenty words:

window	page
leaf	cob
pillow	axle
button	lever
nose	blade
smokestack	sail
cogwheel	coach
cover	cylinder
letter	beak
petal	stamen

Directions: Tell S that each of the words before him names a part of something. After each one he is to write a word meaning the whole of which that word is a part.

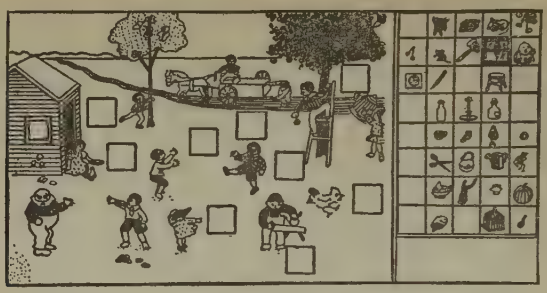
Illustrate with *wheel — engine, toe — foot.*

Scoring: Time limit for entire list sixty seconds for Grades 2, 3, and 4; forty-five seconds for higher grades. Allow one credit for each correct word written.

Norms: [2] 483 Males — 527 Females. (Pyle)

Sex	Age	9	10	11	12	13	14	Adult
M	Average	6.5	7.3	8.9	8.9	11.1	12.2	18.5
	A. D.	2.9	2.5	2.8	3.4	4.3	4.1	3.6
F	Average	5.9	7.8	10.0	10.0	10.8	12.5	19.7
	A. D.	2.4	2.9	3.5	3.7	3.5	3.2	3.4

[1] **58**, pp. 31–33.
[2] For fuller norms, *ibid.*, p. 32.



20. PICTORIAL COMPLETION TEST I — HEALY [1]

Material: Board and fifty pieces, as illustrated above.

Directions: Place board in front of S with blocks in random order above. Say, "Look at this picture and see what is happening. Look what the people are doing. You are to fill in these empty spaces so as to make the picture look right; so as to make the best sense. Any of these blocks up here will fit into any of these spaces." [2] Illustrate with *wheel* block. Use this in any way you wish to try to make S understand what the task is. After S has finished always ask him to look it over again to be sure that every piece is just the one he wants.

[1] **133**, pp. 189–203.
[2] Pintner, Anderson, **141**, p. 17.

Scoring: Score is based on credit given each piece as below.[1]

Broken Window	
Broken Window	100
Closed Window	32
Blank	2
Cage	1

Dog	
Dog	64
Baby	2
Blank	2
Departing Cat	2
Broken Window	1
Cat	2
Hatchet	1
Mouse	1
Standing Bird	1
Stool	1

Log	
Log	52
Hatchet	6
Stool	2
Blank	1

Basket	
Basket	55
Cherries	7
Bucket	2

Cat	
Cat	81
Baby	4
Chicken	2
Departing Cat	7
Milk Bottle	4
Flying Bird	2
Sleeping Cat	2
Cup	1
Fruit	1
Standing Bird	1
Stool	1

Football	
Football	84
Baseball	21
Cherries	2
Flying Bird	1
Pumpkin	1

Flying Bird	
Flying Bird	87
Standing Bird	18
Cage	7
Cherries	3
Basket	2

Hat	
Hat	65
Baby	3
Purse	3
Cat	2
Mouse	2
Books	1
Flying Bird	1
Chicken	1
Dog	1

Chicken	
Chicken	58
Cat	2
Cherries	2
Standing Bird	2
Baby	1
Cage	1
Departing Cat	1
Flying Bird	1
Hatchet	1
Mouse	1

Norms:[2] 1538 cases. (Pintner, Anderson)

Age	5	6	7	8	9	10	11	12	13	14	15	16
Normal Range	5 to 38	39 to 101	102 to 183	184 to 272	273 to 324	325 to 359	360 to 381	382 to 409	410 to 436	437 to 441	442 to 449	450 and over

[1] Pintner, Anderson, p. 58.

[2] For fuller norms, *ibid.*, pp. 70–77.

21. PICTORIAL COMPLETION TEST II — HEALY

Material: Board and sixty pieces in standardized places — *see Plate facing page 79.*

Directions: E says, "The picture begins here" (pointing to demonstration picture) "where the boy is getting dressed. It shows the *same boy* doing one thing after another during the same day." (Point along the first row, then along the second, to show the sequence of the pictures.) "You see in each picture a piece is missing and these pieces fit in any of the spaces. Pick out the one that is best to complete the sense of the picture. Fill up this space first" (pointing to the demonstration picture). E must be sure that S understands that one piece only is exactly right for this picture and tells him to study each picture carefully to make the right placing. After spaces have been filled E asks if S is quite satisfied, if not, he is told that he may make further changes. If it seems probable that a correct placing has been made by chance, S is asked to give reasons for placing and if he accepts an inferior choice, credit is given for that piece accordingly.

Scoring: Record time. Time limit twenty minutes. Total score is sum of values of pieces as finally placed; the values are computed from table below, minus five being value for all placings where no numbers are given.

Pieces	I	II	III	IV	V	VI	VII	VIII	IX	X
1	.	.	.	.	2	.	.	.	.	**12.5**
2	0	0	1	2	.	0	0	0	0	0
3	.	.	.	.	.	.	1	**15.5**	.	.
4	.	.	.	.	0	.	.	.	.	6
5	.	.	.	.	.	.	0	0	0	.
6	0	.	.	0	.	.	.	.	.	.
7	0	0	1	2	.	0	0	0	0	0
8	**6**	.	.	2	.	.	.	.	.	.
9	.	5	0	.	0	.	.	.	.	0
10	0	.	.	1	.	.	.	.	.	.
11	1	.	.	8	.	.	.	.	.	1
12	.	0	.	.	0	.	.	.	.	1
13	.	5	0	.	3	.	.	.	.	.
14	.	.	.	.	.	.	1	6	.	.
15	.	.	1	.	.	1	0	0	0	.
16	.	.	.	.	.	.	0	0	0	.
17	.	.	.	.	.	.	1	6	.	.
18	.	.	0	.	.	**9.5**	.	0	.	.
19	.	2	.	.	0	.	.	.	.	0
20	.	.	.	.	.	.	.	.	.	.
21	.	0	.	.	1	.	.	.	.	0
22	.	.	.	.	2	.	.	.	.	6
23	1	.	.	**18**	.	.	.	.	.	.
24	.	.	.	.	0	.	.	.	.	6
25	.	.	.	.	.	.	2	0	0	.
26	.	.	0	.	.	4	0	0	0	.
27	.	5	0	.	1	.	.	.	.	0
28	.	.	0	.	.	4	0	0	0	.
29	.	.	.	.	.	.	.	.	.	0
30	2	.	.	2	.	.	.	.	.	.
31	1	.	.	8	.	.	.	.	.	.
32	.	0	.	.	7	.	.	.	.	0
33	.	.	.	.	.	.	1	7	.	.
34	.	.	.	.	.	.	**5.5**	0	0	.
35	.	.	**11**	.	0	0	.	.	.	0
36	.	.	1	.	.	2	0	0	0	.
37	.	0	4	.	0	0	.	.	.	0
38	.	.	.	.	.	.	.	.	.	0
39	.	.	.	.	.	.	0	0	1	.
40	.	.	.	.	.	.	.	.	.	1
41	.	0	.	.	2	.	.	.	.	0
42	0	.	.	2	.	.	.	.	.	.
43	.	0	.	.	2	.	.	.	.	0
44	.	.	1	.	.	1	0	0	0	.
45	3	.	.	2	.	.	.	.	.	.
46	0	0	6	0	0	0	.	.	.	0
47	.	5	0	.	1	.	.	.	.	2
48	.	.	.	.	.	.	0	0	**5**	.
49	.	**10**	0	.	1	.	.	.	.	2
50	0	.	.	.	.	.	0	0	1	.
51	0	0	1	2	.	0	0	0	0	0
52	1	.	.	8	.	.	.	.	.	.
53	0	0	1	2	.	0	0	0	0	0
54	.	.	.	.	.	.	0	0	0	.
55	.	.	6	.	0	0	.	.	.	0
56	.	.	.	.	.	.	2	0	0	.
57	.	.	.	.	.	.	0	0	1	.
58	0	0	1	2	.	0	0	0	0	0
59	.	.	.	.	.	.	0	0	2	.
60	.	0	2	.	0	0	.	.	.	0

Norms:[1] 1542 cases. (Healy, Bronner)

Ages	7	8	9	10	11	12	13	14	15	16	17–20	20–50
75 percentile	24	41	48	59	63	66	69	72	76	75	76	78
Median	9	27	37	47	54	55	58	62	64	66	65	65
25 percentile	–6	7	23	32	41	45	50	52	54	54	54	54

[1] **134**, pp. 225–239.

22. PROVERBS TEST — THURSTONE

Material: Two sets each of twenty printed proverbs. Each proverb in one set corresponds in meaning to one proverb in the other set. An illustrative pair is shown below:

(4) Fine feathers do not make fine birds. ( ) Clothes cover character.

Directions: S is instructed to match in meaning the twenty proverbs.

Scoring: Final score is number correct.

Norms: 1749 cases. (Shimberg, Lowe) [1]

Sex	Grade	VII	VIII	IX	X	XI	XII
M	Average	6.8	9.4	10.7	11.2	15.5	15.5
	S. D.	4.1	5.1	5.3	4.2	4.0	4.3
F	Average	6.9	7.9	9.5	12.1	12.8	14.1
	S. D.	4.5	5.2	4.8	4.9	4.9	4.8

[1] Judge Baker Foundation Study as yet unpublished.

23. RANGE OF INFORMATION TEST — WHIPPLE [1]

Material: One hundred words so selected that "each shall be representative of some specific field of knowledge or activity" [2] as follows:

ageratum	cleistogamous	infusoria	puer
amphioxus	cosmogony	intaglio	pyramidal tract
amphora	cotangent	Kepler's law	quadratics
annealed	dibble	kilogram	rococo
Anthony Wayne	dietetics	kinesthetic	R. S. V. P.
apocalypse	dryad	kinetic	scherzo
architrave	electrolysis	Les Misérables	semaphore
aujourd'hui	Elohim	linotype	simony
Babcock test	entrée	logos	spoils system
base-hit	Eocene	luff	Stoicism
Bernard Shaw	Euclid	Malthus' law	synecdoche
Bokhara	f-64	metacarpal	testudo
Braille	f. o. b.	midiron	tort
call-loan	gambit	Millet	trephine
calorie	gasket	mitosis	triangulation
cantilever	glycogen	morgen	trilobite
Caedmon	gneiss	nada	triple-expansion
catalepsy	golden section	natural selection	undistributed middle
cephalic index	guimpe	noi	Utopia
ceramics	hedonism	ohm	vantage-in
chamfer	hemiptera	parallax	way-bill
Chartism	homiletics	peneplain	Weismannism
chlorine	hydraulic press	Pestalozzi	wig-wag
chromosome	impetigo	Polonius	x-ray
clearing house	impressionism	pomology	Zionism

Directions: S is asked to write *D* beside each word he can define; *E* beside each word he can explain; *F* beside each word which is merely familiar, and *N* beside each word that is new. Then he is told to define or explain the first five words which he has marked *D* or *E*.[3] Time limit thirty minutes.[4]

Scoring: Total number of words in each class.

Norms: [5] 344 college students. (Smith)

Classification	*D*	*E*	*F*	*N*
Seniors	*24.9*	*16.7*	*19.3*	*39.1*
Juniors	20.5	14.4	20.7	44.4
Sophomores	21.1	12.1	19.1	48.7
Freshmen	13.7	10.7	15.5	60.1

[1] **157**, pp. 347–351. [2] Whipple, **67**, p. 317.

[3] For more accurate results S is required to define each word he has marked *D* and attempt to explain each word marked *E* or *F*.

[4] Norms were established on this basis, but thirty minutes proved to be too short. Whipple set no time limit.

[5] Smith, **156**, pp. 517–518.

24. REVISED DIRECTIONS TEST — PINTNER-TOOPS [1]

Material: [2] Printed sheet of directions, *e.g.:*
Put a dot below this line: ——
Show by a cross when the nights are longer: in summer? —— in winter? ——

Directions: Say, "Fill this blank out according to directions. Do exactly what you are told to do on the paper." [3]

Scoring: Time limit eight minutes. No partial credits allowed. Score as follows:

Directions 1–8, one credit each
" 9–11, two credits each
" 12, Part I, one credit
" 12, Part II, two credits
" 13–14, three credits each
" 15, four credits

Final score is total number of credits.

Norms: [4] 2366 cases. (Pintner, Toops)

Age	6	7	8	9	10	11	12	13	14	15	16	17	sup. adult
Median	1	4	8	10	11	12	13	15	18	19	20	21	24

[1] **116**, pp. 123–142.

[2] This is a modification and combination of the Easy and Hard Directions Tests devised by Woodworth, Wells, **170**, pp. 68–72. These forms are still available.

[3] Pintner, Toops, **116**, p. 140.

[4] For fuller norms, *ibid.*, pp. 127–142. It is to be noted, however, that the statistical procedure by which the norms were derived renders them only tentative, as the authors themselves state.

25. SCALED INFORMATION TEST — LOWE-SHIMBERG

Material: Printed blank containing twenty-five graded questions, pertaining to general or common-sense information; *e.g.:*

3. How many hours are there in a day?
24. What is the function of respiration?

Directions: S is instructed to answer in writing each question on the blank.[1]

Scoring: Time limit fifteen minutes. Special key required for scoring answers. Raw score, *i.e.*, total number correct, must be translated into T-score before norms can be utilized.

Norms:[2] (*a*) 6265 cases. (*b*) 6639 cases. (Shimberg, Lowe, Meehan)

Raw Score	T Score	(*a*) Grade	Average	S. D.
0	15	IV	40.7	9.0
1	18	V	47.8	9.0
2	21	VI	50.2	9.0
3	25	VII	54.7	8.1
4	27	VIII	58.6	7.9
5	29	IX	60.9	7.8
6	31	X	61.2	8.1
7	34	XI	65.5	8.5
8	37	XII	68.9	9.1
9	39	College Fresh. (F)	81.8	5.2
10	42	College Senior (F)	84.9	5.3
11	45			
12	48			
13	50	(*b*) Age	Average	S. D.
14	54			
15	57			
16	60	9	42.2	9.3
17	63	10	43.6	9.3
18	65	11	47.5	9.3
19	68	12	50.1	10.0
20	71	13	54.7	10.1
21	76	14	57.4	9.3
22	79	15	59.4	9.1
23	82	16	61.7	8.8
24	85	17	64.5	10.4
25	91	18	68.8	8.6

[1] This test can of course be given orally, but under such conditions norms as given above are not known to be strictly applicable.

[2] Judge Baker Foundation study as yet unpublished.

26. SENTENCE VOCABULARY SCALE — HOLLEY [1]

Material: Printed blanks containing seventy sentences as illustrated below. Test applicable to Grades III–VIII.

Directions: E and S together read directions on blank:

"Apples grow on . . . vine . . . roots . . . grass . . . trees.

The word ' trees ' has a line under it because it is the word which makes a true sentence." S is told to underline the word which will make a good sentence out of each of the seventy sentences on sheet. (There is no time limit.)

Scoring and **Norms** supplied with material.

[1] 50, pp. 30–32.

14. This man is playing in a bowling alley at his club. Each player rolls two balls, one after the other. This man has already rolled one and you may make a little circle in front of him to show where it went, and after that make two more just behind him for the next player to use.

27. SILENT READING TEST — BURGESS [1]

Material: Printed blank containing twenty pictures, each accompanied by a paragraph giving instructions, as illustrated above. Test applicable to Grades III–VIII.

Directions, Scoring, and Norms supplied with material.

[1] 105.

28. SILENT READING TEST — MONROE [1]

Material: Three printed leaflets of tests. Test I is for Grades 3, 4, and 5; Test II for Grades 6, 7, and 8; and Test III for Grades 9, 10, 11, and 12. Each test consists of sixteen exercises as illustrated below:

I am a little dark-skinned girl. I wear a slip of brown buckskin and a pair of soft moccasins. I live in a wigwam. What kind of girl do you think I am?

Chinese French Indian African Eskimo.

Directions, Scoring, and Norms supplied with material.

[1] **112**, pp. 303–312; **113**, pp. 600–608.

29. SILENT READING TEST — THORNDIKE-McCALL[1]

Material: Blank containing eleven passages graded in difficulty and three or four questions based on each of these passages.

Directions, Scoring, and **Norms** supplied with material. Test applicable to Grades II–XII.

[1] McCall, **111**, pp. 31–51.

30. SYLLOGISMS TEST[1] — THURSTONE

Material: Two alternative series, each containing twenty arguments, *e.g.*:

> William has a brother, George, who has a son, Henry. Therefore Henry is William's uncle.

Directions: S is instructed to make a plus sign after the argument if the conclusion is true; a minus sign if the conclusion is false.

Scoring: Score is number correct minus number wrong. Disregard omissions.

Norms: (Form A) 529 Males — 600 Females. (Lowe, Shimberg)[2]

Sex	Grade	VII	VIII	IX	X	XI	XII
M	Median	6.6	7.2	8.7	10.9	12.2	14.9
	S. D.	4.6	5.0	4.9	5.2	4.4	4.8
F	Median	4.5	7.0	7.1	9.1	11.0	12.1
	S. D.	4.4	5.0	5.8	4.4	5.5	5.0

[1] First published by Carnegie Institute of Technology, 1919.
[2] Judge Baker Foundation Study as yet unpublished.

31. WORD-BUILDING TEST [1] — WHIPPLE

Material: [2] Blank with following letters written at the top: A E I R L P.

Directions: Tell S to make as many words as he can from the six letters. Illustrate the procedure with other letters, pointing out that he may not use the same letter twice in the same word and that he may use no other letters.

Scoring: Time limit five minutes. Score is the number of correct words. Only the following words are allowed: a, ail, air, ale, alp, ape, April, are, Ariel, ear, Earl, earl, Eli, era, I, Ira, ire, Rae, rail, rale, rap, rape, Rea, real, reap, rial, rile, rip, ripe, lair, lap, lea, leap, Lear, liar, lie, lier, lip, pa, pail, pair, pal, pale, paler, par, pare, pea, peal, pear, pearl, per, peri, peril, pia, pie, pier, pile, pirl, plea, plier.

Norms: [3] 3462 cases. (Pintner)

Age	6	7	8	9	10	11	12	13	14	15	16	Ad.
80 percentile	1	3	5	7	9	11	12	13	14	15	14	23
Median	0	1	3	4	5	6	8	9	10	11	11	18
20 percentile	0	0	1	2	3	3	4	5	6	7	7	16

[1] Whipple, **122**, pp. 94–105. Pintner, **56**, pp. 19–22, 87–88.
[2] For additional norms and alternative material *see* Pyle, **58**, pp. 22–24.
[3] For fuller norms *see* **56**, p. 34.

CHAPTER 4

Memory and Learning Tests

32. Auditory Verbal Memory
33. Aussage
34. Card-Sorting
35. Cube Imitation
36. Digit Memory Span — (Auditory)
37. Digit Memory Span (Auditory Visual Motor)
38. Digit-Symbol Substitution
39. Folded Drinking Cup
40. Four-Detail Drawing
41. Ideational Learning
42. Instruction Box (Hayes)
43. Learning B (Rote Visual Auditory)
44. Learning C (Motivated Associations)
45. Learning D (Ideational)
46. Learning Z (Rote Visual)
47. Logical Memory
48. Marble Sorting
49. Memory for Objects
50. Rational Learning
51. Rote Memory for Words
52. Visual Design (Healy)
53. Visual Recognition (Forms)
54. Visual Recognition (Pictures)
55. Visual Verbal Memory

For unstandardized tests belonging to this category, see Tests 112, 115, 119, 121, 123.

32. AUDITORY VERBAL MEMORY TEST[1] — HEALY-FERNALD

Material: A passage as follows:

If a sailor
on the ocean
is shipwrecked
in a wild country
he must first look for water to drink
then he must find a place to sleep
where wild animals won't get at him
and after that he can take time to look for food
but he must be careful not to eat poisonous berries or fruit
next he had better hunt for other people on the land
and put up a flag
to stop ships which may be going by.

Directions: Say " Listen while I read this passage aloud, and then you are to repeat as much as you can remember." Explain to S that he may have three readings[2] or that he may reproduce the passage after the first or second reading if he feels sure of it.

Scoring: Use blank to check items as they are reproduced, and record variations. Count number of correct ideas and approximate or half correct items.

Norms:[3] 350 cases. (Shimberg, Lowe)

Nine ideas is the average number retained by subjects over twelve years of age.

[1] Healy, Fernald, **49**, pp. 36–37.

[2] The original directions on which the norms are based allowed four readings before any attempt at reproduction.

[3] For other norms *see* Schmitt, **91**, pp. 119–120.

33. AUSSAGE TEST [1] — HEALY-BRONNER

Material: Special colored picture of butcher shop. Sheet of questions for E.

Directions: Tell S that he is to look carefully at the picture of a butcher shop and tell what he has seen. He is warned that E is going to question him about things that may or may not be in the picture. S holds picture and observes it for ten seconds. Then it is taken away and he is told to relate what he has seen (free recital). E questions him concerning points given on sheet not previously covered in free recital. (It is to be understood that items on the sheet merely serve as memoranda and that E must frame questions about them as naturally as possible, and not necessarily in the order given; *e.g.*, "Was there a dog?" or, "What kind of dog was it?" *not*, "Was it a fox terrier?" Seven suggestions are interspersed during the examination.

Scoring: Record free recital. Also check and annotate items on sheet so as to secure objective record. For statistical scoring, corresponding to the forty items, record number correct, errors, and uncertainties. Fictional items and suggestions are counted separately.[2]

Norms: [3] 360 cases (10–17 years of age). (Healy-Bronner)

Number Correct			Average Errors	Average Uncertain	Per Cent. Giving Fictional Items		
75 Per-centile	50 Per-centile	25 Per-centile			Sex	2 to 5 items	6 items and over
31 to 32	28 to 29	24 to 26	5	6 to 7	Male	38%	3%
					Female	35%	8%

[1] Healy-Fernald, **49**, pp. 21–25. Picture taken from "Jingleman Jack", Saalfield Pub. Co., Akron, Ohio.

[2] To date, no method has been found for combining these ratings adequately. For discussion *see* Part III.

[3] From an unpublished study — Healy-Bronner. This might very properly be called a Testimony Test; we have retained the German name "Aussage" because of its long usage.

34. CARD-SORTING TEST — PYLE [1]

Material: [2] Card-sorting tray with fifteen numbered compartments, and seventy-five cards numbered correspondingly, five cards to each number.

Directions: Shuffle cards thoroughly. Tell S to sort the cards as quickly as possible, putting each card into the compartment with the same number. Three sortings are made, the cards being shuffled three times before each new sorting.

Scoring: Time each sorting. Efficiency score is reciprocal of S's combined score for the three sortings, taken in seconds.

Norms: [3] 1326 Males. 1597 Females. (Pyle)

SCORES (SMOOTHED) BY AGE AND SEX

Sex	Age	8	9	10	11	12	13	14	15	16	17	18]
M	Average	92.2	108.3	124.3	136.0	148.4	165.6	170.2	177.7	191.9	196.3	*185.3*
	S. D.	32.4	32.4	28.1	28.3	33.8	36.7	34.3	38.0	49.1	40.1	*28.1*
F	Average	104.4	123.4	148.7	158.2	164.4	178.0	188.8	192.2	196.0	200.8	*204.2*
	S. D.	28.7	33.8	33.5	36.4	37.8	36.6	38.0	35.3	33.6	34.4	*36.2*

[1] **59**, pp. 14–33.

[2] For a color card-sorting test with a 4-compartment box, *see* Woolley, Fischer, **102**, pp. 100–107; Dewey, Child, Ruml, **44**, pp. 51–53; Woolley, **100**, pp. 52–56.

[3] For fuller norms *see* **59**, pp. 16–25.

35. CUBE IMITATION TEST — KNOX-PINTNER [1]

Material: Five blocks of the same color and size. (The Binet black one-inch cubes or similar blocks should be used.)

Directions: [2] Four cubes are placed about two inches apart in front of S. With the fifth cube in hand, say, "Watch carefully and then do as I do." Tap the cubes in a definite order at the rate of one per second. (Always begin with the cube to the left of S.) Then, giving S the fifth cube, say, "Now you do what I did." Order for tapping:

A. 1 2 3 4	C. 1 4 3 2	G. 1 3 1 2 4
X. 1 2 3 4 3	D. 1 4 2 3	H. 1 4 3 1 2 4
Y. 1 2 3 4 2	E. 1 3 2 4 3	I. 1 3 2 4 1 3
B. 1 3 2 4	F. 1 4 3 2 4	J. 1 4 2 3 4 1

Scoring: Record the number of lines passed or failed. Continue test until three successive lines are failed.

Norms: [3] 855 cases. (Pintner, Paterson)

	Age	5	6	7	8	9	10	11	12	13	14	15	16	Adult
Lines correct	75 Percentile	4	*5*	6	6	7	7	8	8	8	9	8	*9*	*9*
	Median	2	*4*	5	6	6	6	7	7	7	8	7	*8*	*8*
	25 Percentile	1	*3*	4	5	5	5	6	6	6	6	5	*7*	*7*

[1] Knox, **247**, pp. 741–747; Pintner, **184**, pp. 377–401.
[2] Pintner, Paterson, **57**, pp. 67–68.
[3] For fuller norms, *ibid.*, p. 137.

36. DIGIT MEMORY SPAN TEST [1]

Auditory Presentation

Material: Digits arranged in series of increasing length, in such a way that two consecutive numbers are never in juxtaposition, zero never appears, there is no duplication of numbers (unless more than nine in the series), and beginning and ending numbers of a series are always different from those of a preceding group.

Directions: [2] Say to S, "I am going to tell you some numbers to see how well you can remember them." E repeats numbers in a clear, even tone, without rhythm and at the rate of about one per second. Starting with a series well within S's grasp E continues until S is definitely unable to proceed any further. No series is ever repeated. E then says, "Now I am going to tell you some other numbers and see if you can say them backwards." E illustrates with two- and three-place numbers and then proceeds as above.

Scoring: Final score is longest series (forwards and backwards) S can correctly repeat. (To eliminate chance Starr requires two out of four trials to be correct.)

Norms: (*a*) 1449 cases. (*b*) 1267 cases. (Haseltine, Lowe, Shimberg) [3]

(*a*) 2000 cases. (*b*) 1450 cases. (Starr) [4]

Modes for Digits Forwards (*a*) and Digits Backwards (*b*) by Age

Age	4	5	6	7	8	9	10	11	12	13	14	15	16	17+
Digits Forwards														
Haseltine, Lowe, Shimberg	—	—	—	5	5	5 5	5	6	6	6 7 6	6 7 6	7	7	7
Starr	4	4	5	5	5	6	6	6	6	7	7	7	—	—
Digits Backwards														
Haseltine, Lowe, Shimberg	—	—	—	3	3	3 4	4	4 5	4 5	5	5	5	5	5
Starr	F	F	F	3	3	4	4	4 5	5	5	5	5	—	—

[1] Jacobs, **161**, pp. 75–79.

[2] We have described here the method in use at the Judge Baker Foundation. It is sufficiently similar to that described by Starr, **188**, pp. 63–64, to allow comparison of norms.

[3] Judge Baker Foundation study as yet unpublished.

[4] For additional norms on retarded, subnormal, and defective children *see* **188**, p. 64.

37. DIGIT MEMORY SPAN TEST

AUDITORY — VISUAL — MOTOR PRESENTATION

Material:[1] Six printed test cards, large type. (Two cards each of seven, eight, and nine digits). Sample card with five digits. Metronome.

Directions:[2] S is told he is to read some numbers aloud, one to each beat of the metronome, and then the card will be taken away and he is to write the numbers. Illustrate with sample card until S understands. Before each presentation S is told how many numbers are on the card. Allow metronome to beat until S has finished writing last series.

Scoring:[3] For correct digit in correct place, credit two points. For one mistake in series subtract two points.

If more than one error has been made in single series credit as follows:

For every correct digit one place removed one credit except that in correct sequence of three or more digits allow one for first digit, if one place removed from correct position. More than one place, no credit. For others in sequence two credits each.

Reduce value of each series to percentages and obtain average for each pair. For composite score add three values.

Norms:[4] 2979 Males. 2391 Females. (Woolley)

COMPOSITE SCORES BY AGE

Sex	Age	14	15	16	17	18
M	75 percentile	262	273	285	288	287
	50 percentile	236	248	266	270	271
	25 percentile	208	223	241	240	242
F	75 percentile	266	275	285	289	290
	50 percentile	241	251	267	273	277
	25 percentile	212	220	244	245	254

[1] This test can be given in a variety of ways, *e.g.*, visual presentation, auditory-visual presentation, etc. For details *see* Whipple, 67, pp. 155–162.

[2] Woolley, 100, pp. 88–91.

[3] *Ibid.*, pp. 91–92.

[4] For fuller norms (including per cent. correct for each series), *ibid.*, pp. 89–94.

38. DIGIT–SYMBOL SUBSTITUTION TEST — PYLE [1]

Material: [2] Printed blanks containing digit-symbol key (symbols alone are reproduced above), and forty series of five-place numbers.

Directions: Tell S to see how many of the squares he can fill in according to the key at the top of the test blank. S is provided at first with two of the same blanks to fill in.

Scoring: Time limit five minutes. Efficiency score is number of substitutions correctly marked.

Norms: [3] 3729 Males. 4023 Females. (Pyle)

Sex	Age	8	9	10	11	12	13	14	15	16	17	18
M	Average (smoothed)	37.5	47.5	57.5	67.5	77.5	87.5	97.5	107.5	117.5	127.5	137.0
F	Average (smoothed)	42.5	56.0	68.2	80.2	91.6	102.3	112.3	122.3	133.3	138.7	142.0

[1] **59**, pp. 43–47.

[2] For further tests of this kind and supplementary test blank *see* Pyle, **58**, pp. 18–22. (However, author himself considers these superseded by test reported above); Woodworth, Wells, **170**, pp. 53–55; Woolley, Fischer, **102**, pp. 148–184; Woolley, **100**, pp. 79–87.

[3] For further norms *see* **59**, pp. 45–47.

Figure 1

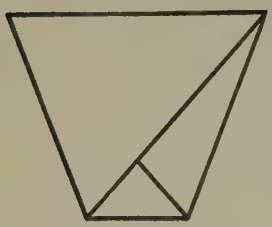
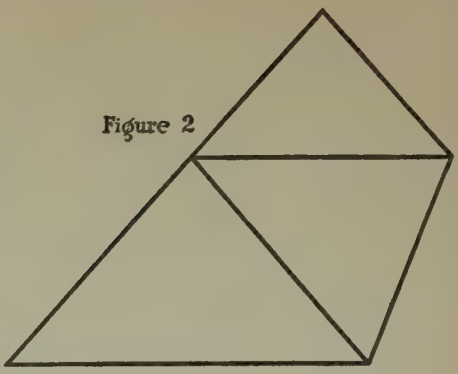


Figure 2



39. FOLDED DRINKING CUP TEST — N. Y. BUREAU OF ANALYSIS AND INVESTIGATION [1]

Material: Two pieces of typewriter paper $8\frac{1}{2}$ inches *square*.

Directions: Tell S he is to make a drinking cup after being shown each step. Say, "First I fold this square of paper three-cornered-wise through the center (*Move 1*). Then I take this corner (the right-hand acute angle) and fold it over to the opposite side (*Move 2*), so that these two edges are equal (pointing to the arms of the isosceles triangle left in the vertex, as in *Fig. 2*). Next I take the other corner (left acute angle) and fold it over in the same way so that the edges come straight across (*Move 3*). Then I fold this flap down (folding down the top upper flap) and put it into this outer space to hold it (*Move 4*). Then I fold down the other flap (*Move 5*). You see how it looks. Now make one like it." Sample (*Fig. 1*) is left in plain view.

Scoring: Record time and note S's method of procedure.

Norms: [2] 494 cases — institutional children. (N. Y. Bureau of Analysis)

Average number of moves for seven to fifteen years is five. Average time for different ages ranges from sixty-seven to forty-three seconds.

[1] 39, pp. 42–49.
[2] For fuller norms, *ibid.*, pp. 47–48.

40. FOUR-DETAIL DRAWING TEST [1]

Material: Sheet of paper. Box of crayons in six colors.

Directions: Read the following story aloud and tell S to try to form a mental picture of its contents.

KINDNESS TO ANIMALS

The wagon was heavily loaded with bars of iron. It looked too heavy for a single horse to draw. The patient creature had strained and tugged, until he succeeded in reaching the top of the hill. Now he must back the heavy load in at the open door of the barn.

"Back, Jim, back!" said the driver, pulling lightly at the reins.

The horse braced his forefeet and pushed, but the wagon did not move. The man got down from the seat, went to the back of the truck and pulled.

"Back!" he cried.

The horse strained every muscle.

"Back!" cried the driver again.

The wagon moved this time at least a foot. Once more the driver pulled and the horse pushed, together.

"Back!"

With the last command, the great horse shoved with all his might. There was a sound of splintering wood, and the wagon rolled back. Not a blow had been struck. Only gentle words had been spoken, and the horse had done the rest. The man went to the horse's head, took his nose in his hands, patted him between the eyes, and said,

"Good old Jim! You did it, didn't you? I knew you would."

The horse rubbed his nose against the man's cheek.

Repeat following quotation twice: "The patient creature must back the heavy load into the open door of the barn." "'Back, Jim, back!' said the driver." Tell S to illustrate quotation, putting in all details mentioned.

Scoring: Scoring is based on number of ideas incorporated in drawing. The merit of drawing is not considered. To be entirely correct drawing must contain four details cited in the quotation; horse backing; wagon; driver; open door. Drawing also considered successful which (1) merely shows that an open door must necessarily be understood, and (2) fails to show that the horse is backing.

Norms: [2] 610 cases. (N. Y. Bureau of Analysis and Investigation) This test is to be placed at eleven years mental age since approximately seventy-five per cent of these children were successful. Above this age performance was almost one hundred per cent perfect; below this age it decreased steadily to seven years.

[1] N. Y. Bureau of Analysis, **40**, pp. 75–111. This bulletin also contains a very similar test incorporating three details, pp. 112–117.

[2] For fuller norms, *ibid.*, p. 93.

41. IDEATIONAL LEARNING TEST — PYLE [1]

Material: Six graded stories, A and B for high school grades; C and D for grades 6, 7, 8; E and F for grades 4 and 5.

Directions: Tell S to read and study the story printed on the test sheet and try to learn it as completely as possible. At the end of five minutes he is to be examined to see how much he has learned. It is emphasized that facts, not words, are to be remembered. After the reading period is over, S is given five minutes to answer questions on another sheet.

Scoring: Correct answers and corresponding credits supplied with material.

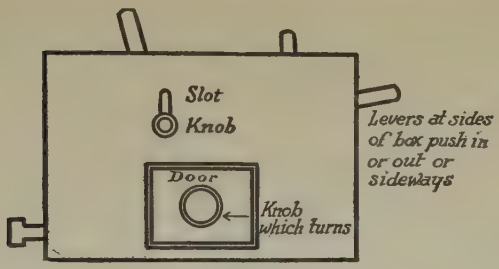
Norms: [2] 428 Males — 560 Females. (Pyle)

AVERAGE SCORES FOR MALES AND FEMALES

	STORIES											
	A		B		C		D		E		F	
Sex	M	F	M	F	M	F	M	F	M	F	M	F
Age												
9									*5.0*	*6.9*	*5.7*	*7.1*
10									6.6	*7.4*	7.9	*7.9*
11					5.0	5.2	9.1	10.8				
12					*5.2*	5.4	*10.5*	11.0				
13					5.4	5.6	10.7	11.2				
14	10	9.0	6.5	6.5								
15	10.6	9.6	7.8	6.6								
16	11.3	10.5	8.0	8.6								
17	*14.1*	11.2	*11.0*	9.1								

[1] **59**, pp. 60–81.

[2] For fuller norms, *ibid.*, pp. 77–81.



42. INSTRUCTION BOX TEST — HAYES

Material: Instruction box, general plan of which is given above. Diagram of box and steps necessary for opening.

Directions:[1] Box is placed before S, who is told that if the knobs and levers are moved correctly one after the other the door will open. E then removes box and shows S the diagram, pointing out that this shows the steps necessary for opening it. S is told that he will be given one minute to study the diagram and then, without it, he will be asked to open the box. If S is unsuccessful at first trial the test is repeated, the diagram being exposed this time for thirty seconds. A third trial repeating the method of the second trial may also be given.

Scoring: Final score is number of trials necessary for opening box. If unsuccessful on third trial, count as failure.

Norms:[2] 464 Males. 361 Females. (Woolley)

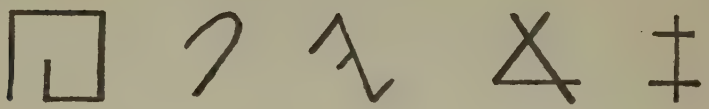
NUMBER OF TRIALS REQUIRED FOR 17-YEAR-OLDS

Sex	90 percentile	50 percentile	10 percentile
M	1	2	3
F	1	2	F

[1] Woolley, 100, pp. 145–146.
[2] For fuller norms, *ibid.*, p. 144.

3a

3b



43. LEARNING B TEST — HEALY-BRONNER

Material: Six rows of five symbols arranged in varying orders. Key of names for E.

Directions: Detach key. Place row (1*a*) of symbols before S. Say, "Suppose you were going to learn a new language. You would have to know what each letter was called, wouldn't you? I am going to tell you the names of these letters and I want to see how quickly you can learn them. This (pronouncing it emphatically and pointing to first symbol) is called *Ree.* You say it." Similar procedure with other four symbols, allowing about three seconds between each. Then, exposing only row (1 *b*), say, "What is the name of this one?" (pointing to first symbol). Repeat with each symbol in order. If necessary allow two more trials, using same procedure of learning and recall with the other rows of symbols.

Scoring: Record number correct at each trial. Final score is total of three trials. (If S is successful on first or second trial add five for each possible remaining trial.)

Norms:[1] 633 cases. (Regensburg)

The average scores range from seven to nine for ages nine years to adult.

[1] From an unpublished study.

44. LEARNING C TEST — HEALY-BRONNER

Material: Designs, as above, mounted on one-inch wooden cubes or on little boxes. Key of values, twenty cents, thirty cents, forty cents, etc., for E.

Directions: Detach key and keep hidden from S. Say to S: "If you were to get a job selling in a store, you would have to know the prices, wouldn't you? I am going to see how quickly you can learn how much different things cost. You see this block" (placing before him the sixty-cent block). "This is worth sixty cents." Expose about three seconds. Remove the block from view. Show others in similar fashion, following presentation order I below. After all seven have been given, present blocks in recall order I, saying each time, "How much is this worth?" Give two more trials, if necessary, following exactly the order of presentation and recall given below.

I	Presentation	60	30	50	20	80	40	70
	Recall	30	80	20	50	70	40	60
II	Presentation	50	70	30	80	20	40	60
	Recall	40	80	50	70	20	60	30
III	Presentation	80	60	30	20	50	70	40
	Recall	20	40	70	50	80	30	60

Scoring: Record number correct at each trial. Final score is sum of the three trials. (If S is successful on first or second trial add seven for each possible remaining trial.)

Norms:[1] 633 cases. (Regensburg)

The average scores range from eleven to fifteen for all ages, *i.e.*, nine years to adult.

[1] From an unpublished study.

45. LEARNING D TEST — HEALY-BRONNER

Material: Special pictures A and B. See plate.

Directions: S is given picture A and directed to look at it both during the reading of the passage and recall. E says, "See if you can remember what I tell you about this picture." (The following passage is read slowly and with clear pauses between each of the ten points as indicated.)

Indians once lived here.| And they first made this trail.| Gold is found here,| in the rocks.| The soil in the valley is very deep.| It was all washed down from the mountains,| which are forty miles away.| Figs grow here.| It is near the largest city in the state.| Two railroads end in the city.

If necessary give two more trials following above procedure.[1]

Scoring: Score one for each unit correctly reproduced (exact wording not necessary), and one-half for each unit about half correct. Final score is sum of three trials. (If S is successful on first or second trial, add ten for each possible remaining trial.)

Norms:[2] 623 cases — Picture A. (Regensburg)

Age	9	10	11	12	13	14	15	16	Adult
Average	17.4	18.3	21.9	21.5	24.1	24.8	24.4	24.5	24.0

[1] For alternative testing use picture B and following passage with procedure described above.

This station is on the other side of the world.| Trains come into it only from the north and west.| The waiting room is on the second floor.| Not far away from the city is a large desert.| One of the finest harbors on the Pacific Coast is here.| The people speak English.| The natives have dark skins.| The city has a wool market.| The country was settled in 1835.

This passage is unstandardized but high correlation has been found between A and B.

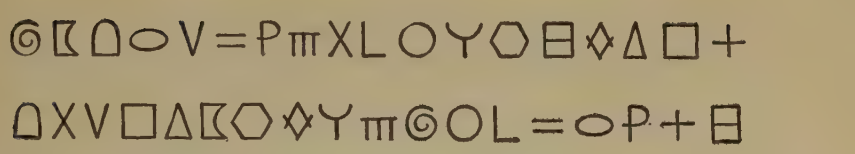
[2] From an unpublished study.

PICTURE A

PICTURE B

TEST 21

(*See page 52*)



46. LEARNING Z TEST[1] — HEALY-BRONNER

Material: Six rows containing in varying order the eighteen symbols illustrated in the two lines above. Key containing same symbols, numbered one to eighteen.

Directions: Place before S key and blank folded, so that only one row of symbols is visible. Say, "You see (pointing to key) each one of the figures in this row has a number on it. Here (pointing to second row) are the same figures without any numbers. I want you to write on each figure the number that belongs to it. Look at them carefully and try to learn them because afterwards I am going to see how well you can remember them." For grades seven and above, allow one and one-half minutes; for grades below allow two minutes for filling in numbers, telling S to use any spare time in learning. At the end of the time (and not before) take away the key and say, "Now fill in all you can remember." If recall is imperfect, E says, presenting third row, "That was pretty good for the first time. Now fill them in again from the copy and see if you can remember more this time." The fourth row is then given for filling in from memory. A similar third trial with the two remaining rows is given if necessary.

Scoring: Score one for each symbol correctly numbered. Final score is addition of three trials. If S gets perfect score on first or second trial, eighteen is added for each remaining possible trial.

Norms: (*a*) 772 cases. (*b*) 856 cases. (*c*) 772 cases. (Shimberg, Lowe, Meehan)

[1] This is a modification of Learning A reported on by Morgenthau, **54**.
[2] Judge Baker Foundation study as yet unpublished.

(*a*) Age	8	9	10	11	12	13	14	15	16	17	18
Average Score	*30.2*	30.4	31.3	30.6	33.2	36.9	37.1	40.0	38.5	36.7	*36.7*
S. D.	*11.2*	11.4	10.3	10.8	11.9	10.8	11.0	9.2	9.0	9.8	*11.2*

(*b*) Grade	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Average Score	30.1	29.3	31.3	32.4	29.8	38.0	39.9	42.9	37.9	34.6
S. D.	11.6	11.2	11.0	11.4	11.8	10.5	9.5	7.2	9.4	11.1

PERCENTILES

(*c*)	100	90	80	70	60	50	40	30	20	10	0
Ages 8 to 12 yrs.	53.0	44.89	41.91	38.91	35.87	32.37	28.61	24.71	20.71	15.58	1.0
Ages 13 to 18 yrs.	54.0	50.76	47.19	44.19	41.19	39.49	36.38	32.55	28.02	22.78	6.0

47. LOGICAL MEMORY TEST — SHAW-WHIPPLE [1]

Material: [2] Printed passage — "The Marble Statue", containing sixty-seven ideas, as follows:

A young | man | worked | years | to carve | a white | marble | statue | of a beautiful | girl.| She grew prettier | day by day.| He began to love the statue | so well that | one day | he said to it: | "I would give | everything | in the world | if you would be alive | and be my wife."| Just then | the clock struck | twelve,| and the cold | stone began to grow warm,| the cheeks red,| the hair brown,| the lips to move.| She stepped down,| and he had his wish.| They lived happily | together | for years,| and three | beautiful | children were born.| One day | he was very tired,| and grew | so angry,| without cause,| that he struck her.| She wept,| kissed | each child | and her husband,| stepped back | upon the pedestal,| and slowly | grew cold,| pale | and stiff,| closed her eyes,| and when the clock | struck | midnight,| she was a statue | of pure | white | marble | as she had been | years before,| and could not hear | the sobs | of her husband | and children.

Directions: [3] Tell S that you are going to read him a story entitled, "The Marble Statue", and afterwards he is to write down as much as he can remember. Emphasize the fact that he may use his own words if he wishes but that he is to remember as many ideas and details as possible.

Scoring: Compare the reproduction unit by unit with prepared blank. Allow one credit for each correct idea.

Norms: [4] 1248 Males — 1402 Females. (Pyle)

Sex	Age	8	9	10	11	12	13	14	15	16	17	Adult
M	Average	24.3	28.7	30.0	32.9	35.1	36.8	36.1	36.5	34.4	*34.6*	38.3
	A. D.	6.7	9.1	6.7	5.6	7.4	6.3	7.0	6.7	5.6	*8.7*	7.0
F	Average	28.5	31.0	33.5	36.4	38.1	38.5	39.0	39.1	37.3	36.6	40.1
	A. D.	11.3	9.4	6.8	7.7	7.2	7.1	7.5	6.3	5.1	6.9	5.9

[1] Shaw, **187**, pp. 77–78; Whipple, **67**, pp. 209–221.

[2] For additional, though incompletely standardized forms, *see* Pyle, **58**, pp. 11–14.

[3] *Ibid.*, pp. 7–11.

[4] For fuller norms, *ibid.*, pp. 10–11.

48. MARBLE SORTING TEST — PYLE [1]

Material: [2] Box with nine compartments, each of which has an uncolored picture of an animal on it. A box containing ninety colored marbles. A key showing pictures of nine animals in colors corresponding to the nine colors of the marbles.

Directions: Box containing marbles is placed near S; marble-receiving box just back of it. Color key is placed nearby. S is told to sort the marbles as quickly as possible without making mistakes. Each marble is to be matched in color with the animal having the same color and then to be put in the hole by the picture of that animal.

Scoring: Time limit five minutes. Record number sorted and number of errors. Efficiency score is number of marbles put into receiving box, minus number of errors. In case S finishes in less than five minutes, score is computed on basis of five minutes.

Norms: [3] 639 Males. 652 Females. (Pyle)

SCORES (SMOOTHED) BY AGE AND SEX

Sex	Age . . .	6	7	8	9	10	11	12
M	Average . .	24.7	34.2	41.7	47.4	52.0	56.5	61.2
	Average Errors	4.12	4.74	3.88	6.92	7.51	8.66	8.86
F	Average . .	31.7	37.5	43.5	49.5	55.3	61.5	66.6
	Average Errors	3.54	3.96	4.85	5.61	6.44	8.03	8.63

[1] 59, pp. 34–42.

[2] For a sorting test involving several simultaneous processes *see* manthanometer experiment; *ibid.*, pp. 54–59.

[3] For fuller norms, *ibid.*, pp. 37–42.

49. MEMORY FOR OBJECTS TEST[1] — ELLIS

Material: Ten one-inch metal toy objects.

Directions:[2] Tell S that you are going to show him some objects. Place objects on table or any flat surface, one at a time, beginning at child's left, in order as above. As each object is placed have S name it, helping him if necessary. Then, ask him to name them again and to note their exact order, telling him that objects are to be taken away and that he will have to remember their names in order. The objects are then taken away and S is questioned as to what came first, second, etc. Put objects down as S names them. Wait only thirty seconds for each response. At the end of series allow S to supply any missing objects and question him as to whether he has named them all. Say, " Is that all? Are there any others? "

Scoring: Record S's order of objects. If S knows that he has omitted an object from a certain space, note this. Score ten for each object named. One is deducted for each place object is removed from correct position.

Norms:[3] 500 Jewish cases. (Dewey, Child, Ruml)

Sex	Age	9	10	11	12	13
M	Average per cent.	68.3	73.08	74.0	71.67	72.0
	S. D.	12.0	10.3	13.2	9.94	11.3
F	Average per cent.	72.8	74.1	75.6	78.5	77.9
	S. D.	11.6	13.4	10.2	11.2	12.4

[1] Ellis, Bingham, **45**.

[2] Dewey, Child, Ruml, **44**, pp. 42–44. For different method *see* N. Y. Bureau of Analysis, **40**, pp. 31–40.

[3] For fuller norms *see* **44**, p. 82.

50. RATIONAL LEARNING TEST — PETERSON [1]

Material: Written paragraph of instructions as follows:

Directions: "The letters A, B, C, D, E, F, G, H, I, and J are numbered in a random order from one to ten. I call out the letters in their order and you are to guess numbers for each letter until you get the correct one, when I say, 'Right.' Then I call out the next letter, and so on. This continues until you get each number right the first guess, twice in succession through the series from A to J. Then you are through. You must ask no questions, but are to use all the mental powers at your command in order to complete the learning as soon as possible. You will be ranked by (1) the total time you take; (2) the number of errors or wrong guesses . . . ; (3) the number of repetitions you require. Reread these instructions carefully if necessary." [2] Number letters A 9, B 6, C 2, D 10, E 8, F 1, G 5, H 4, I 7, J 3.

Scoring: Record time. Note errors as follows: *logical* (guessing a number already used for earlier letter); *perseverative* (repeating a number in response to any given letter) and *unclassified.*

Norms: (*a*) 113 college students. (Peterson) [3]
(*b*) 274 children. (Peterson, Harrelson) [4]

(*a*)

	Time Minutes	Repetitions	Errors			
			Logical	*Perseverative*	*Unclassified*	Total
75 percentile	12.3	9.5	26	27	90	117
50 percentile	16.1	12.4	51	9.4	146	204
25 percentile	23.4	17.1	95	17.9	225	331

(*b*)

	Age	8	9	10
Errors	75 percentile	52.1	44.9	26.4
	Median	114.2	96.4	68.8
	25 percentile	187.5	235.0	114.6

[1] **183**, pp. 250–257. [2] *Ibid.*, p. 252. [3] For fuller norms, *ibid.*, p. 254.
[4] For the children, method was slightly modified as follows: Five letters numbered: A 4, B 2, C 5, D 1, E 3, were used. For full explanation of method and fuller norms *see* Peterson, **179**, pp. 93–141.

51. ROTE MEMORY FOR WORDS TEST [1] — PYLE

Material: Six groups of words:

1.	2.	3.	4.	5.	6.
street	spoon	ground	desk	ball	coat
ink	horse	clock	milk	cup	girl
lamp	chair	boy	hand	glass	house
	stone	chalk	card	hat	salt
		book	floor	fork	glove
			cat	pole	watch
				cloud	box
					mat

Directions: Tell S that you are going to read him some lists of words to see how well he can remember them. After the reading of each list he is to write [2] the words in exactly the same order in which they are given. If he forgets a word he may make a line to indicate its omission. Illustrate with the words *dog*, *flower*, *pencil*. Read each list at rate of about one word per second. Never repeat words. Give S plenty of time to complete one list, before reading another.

Scoring: Score two for each correct word in its correct position; one for correct word not in right position. Do not deduct for misspelled or misunderstood words, *e.g.*, pink for ink, deck for desk, cut for cup, etc.

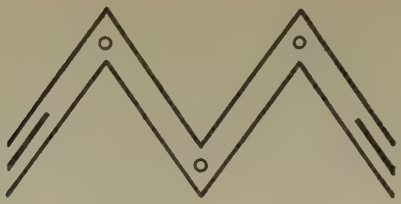
Norms: [3] 3354 cases. (Pintner)

Age . .	6	7	8	9	10	11	12	13	14	15	16
80 percentile	12	25	32	38	42	45	47	49	51	49	50
Median .	3	18	25	31	34	38	41	43	44	43	45
20 percentile	0	7	14	23	27	31	34	35	38	37	38

[1] Pyle, **58**, pp. 14–17; Pintner, **56**, pp. 13–14; 83–85.

[2] In individual testing answers may, of course, be given orally. In this case, above norms are not known to be strictly applicable.

[3] For fuller norms *see* **56**, p. 31.



52. VISUAL DESIGN TEST[1] — HEALY

Material: Design illustrated above. Figure four by two inches.

Directions: S is told that this is not a drawing test, but a test of his ability to remember things he has seen. S is told he is to look at the figure and then, when the card is taken away, to draw it as correctly as he can. Expose card for five seconds in position shown above.

Scoring: Final score is sum of credits, assigned as follows:

Symmetry, (*i.e.*, 2 parts of *M* approximately similar)	1 credit
Shape, (*i.e.*, *M* rather than *W*, etc.)	1 credit
Double lines	1 credit
3 Circles, correctly placed	1 credit
2 Dashes, correctly placed	1 credit
3 Circles, not correctly placed	½ credit
2 Dashes, not correctly placed	½ credit

Norms:[1] 680 cases. (Meehan, Shimberg)

	Age	9	10	11	12	13	14	15	Adult
Scores	75 percentile	4	5	5	5	5	5	5	5
	50 percentile	4	4	4	4	4	5	5	5
	25 percentile	3	3	3	3	3	4	4	4

[1] Judge Baker Foundation study as yet unpublished.

53. VISUAL RECOGNITION FOR FORMS TEST[1] — JONES

Material: Set of fifteen cards, each with a geometrical design, similar to sample above. Set of twenty cards, ten of which are identical with cards in first set. Sample card.

Directions: E tells S that he is to be shown a series of cards, each of which has on it a figure. Illustrate with sample. He is to look at each card very carefully because afterwards he is to be shown another set of cards, some of which are the same and some of which are different. He is to pick out all those he has seen before. E then shows S the first set of cards, exposing them one at a time for five seconds each. Then E gives S the second set, telling him to sort them into piles of cards he has seen and cards he has not seen. If he is not sure about any card he is to guess.

Scoring: Record positive errors (*i.e.*, including as seen a card he has not seen); negative errors (*i.e.*, omitting cards which have been seen.) Deduct ten for each error from perfect score, 100. Minimum score is — 100.

Norms:[2] 358 Males. 277 Females. (Woolley)

	Males 18 years			*Females 18 years*		
	Score	+ Errors	− Errors	Score	+ Errors	− Errors
75 percentile	61.4	1	0	59.6	2	0
50 percentile	48.7	3	1	47.2	3	1
25 percentile	37.0	4	2	29.6	4	2

[1] Woolley, 100, pp. 147–151. [2] For fuller norms, *ibid.*, p. 150.

54. VISUAL RECOGNITION OF PICTURES TEST[1] — FERNALD

Material: Two closely similar sets each of ten black-and-white sketches, postcard size.

Directions: Show a set of the cards to S, one at a time. Tell S to look carefully at each card so that he will remember it when these cards are mixed with some he has not seen. Shuffle the two sets and place all twenty on table, asking S to designate which cards he has previously seen.

Scoring: The score is the sum of the errors in each set.

Norms:[2] 885 cases — institutional subjects. (N. Y. Bureau of Analysis and Investigation)[3]

Mental Age[4] . .	VII	VIII	IX	X	XI	XII	XII+
Average errors . .	5.5	4.9	4.5	3.7	3.3	3.3	2.5
S. D.	3.17	2.43	2.68	2.17	2.31	1.79	2.04

[1] N. Y. Bureau of Analysis and Investigation, **39**, pp. 63–67.

[2] These norms are to be considered only suggestive, because the cards now available are not those with which the test was standardized. The manufacturers say, however, that Fernald has approved this substitution.

[3] For fuller norms, *ibid.*, pp. 64–67.

[4] Mental ages on basis of slightly modified 1908 form of Binet Simon tests or 1911 American revision.

55. VISUAL VERBAL MEMORY TEST [1] — SCHMITT

Material: Special *printed* blank containing twenty lines, beginning as follows:

> If a man finds that the house is on fire
> he should look to see if it is a large fire
> if it is a small one

Directions: Say, "Take time to read the passage through once carefully and then you will be asked to repeat as much as you can remember." Allow only one reading.

Scoring: Use blank to check items (ideas, not necessarily exact verbal reproductions) as they are given and record variations. Count number (*a*) of correct and (*b*) approximate or half correct items.

Norms: [2] 337 cases. (Lowe, Shimberg)

Twelve ideas is the average number retained by subjects over eleven years of age.

[1] Healy, Fernald, **49**, pp. 34–36.

[2] Judge Baker Foundation study as yet unpublished. For other norms *see* Schmitt, **91**, pp. 115–118.

CHAPTER 5

Mechanical and Assembly Tests

56. Assembly Test for Girls
57. Assembly Test of General Mechanical Ability
58. Automobile Construction Test
59. Color Cubes (Maxfield)
60. Constructive Ability
61. Frock and Coat
62. Manual Dexterity Series
63. Mechanical Aptitude
64. Painted Cube
65. Puzzle Box (Freeman)
66. Puzzle Box (Healy)
67. Tower
68. Wheelbarrow and Cradle

For unstandardized tests belonging to this category, see Tests 96, 97, 102, 107, 124.

56. ASSEMBLY TEST FOR GIRLS [1] — INSTITUTE OF EDUCATIONAL RESEARCH

Material: A box containing material for the following eleven projects: (*A*) Stringing beads; (*B*) Inserting tape; (*C*) Rosette; (*D*) Cross-stitch; (*E*) Key ring; (*F*) Clip chain; (*G*) Tape sewing; (*H*) Trunk tag; (*I*) Card wrapping; (*J*) Booklet; (*K*) Trimming paper.

Directions, Scoring and **Norms** supplied with test material.

Illustration by courtesy of C. H. Stoelting Co.

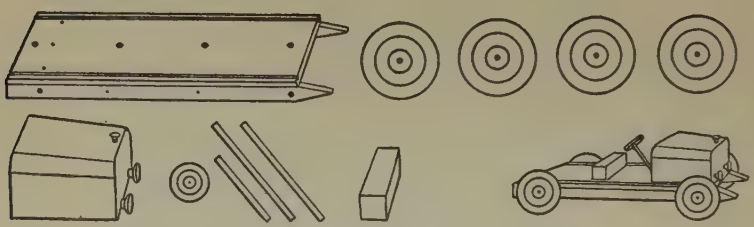
57. ASSEMBLY TEST OF GENERAL MECHANICAL ABILITY — STENQUIST [1]

Material: Three boxes each containing ten unassembled mechanical devices. Series I (illustrated above) and II are alternative tests for Grades 5 and above. Series III is for younger children.

Directions, Scoring in detail, including translation of raw into *T*-scores, and **Norms** in manual supplied with material.

[1] Toops, 301, pp. 40–62. [2] 197.

Figure 1

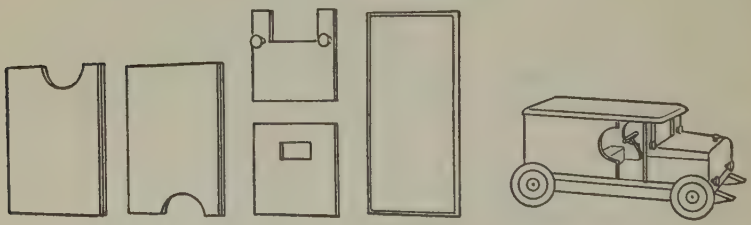


58. AUTOMOBILE CONSTRUCTION TEST [1] — HAYES-DEWEY

Material: Parts of wooden toy automobile as above. (Schoenhut's Five-in-One Auto Build) The 4 side pieces are glued to the body.

Directions: Present pieces shown in Fig. 1. Say, "If you put all these pieces together they will make the running parts of an automobile. Now see how quickly you can put them together." For second part, make corrections if necessary and present pieces for the upper parts as shown in Fig. 2. Say,

Figure 2



"You see these other pieces. Now, if you put these other pieces on just right, they will make a top for the automobile and turn it into a truck. See how fast you can do it." Performance is recorded as a failure if S has not started in 2 minutes.[2]

[1] Dewey, Child, Ruml, 44, pp. 21–23. As originally reported, this was called the Cart Construction Test. The material, however, is so obviously an automobile that we have taken the liberty of modifying this title.

[2] *Ibid.*, p. 21.

Scoring: Time limit 8 minutes for each part. Record time for Parts I and II separately. Record S's procedure move by move.[1]

Each part correctly attached to body . . . . . 2 pts.
Each part incorrectly attached to body . . . . . 1 pt.
Parts fitted together off body . . . . . 0 pts.

Except

(*a*) Wheels fastened to axles and cart balanced on wheels (without axles attached correctly).
(*b*) Both axles, one on each side placed through front or rear hole, wheel on outside end of axle.

for each wheel . . . . . 1 pt.
for axles . . . . . 0 pts.

Norms:[2] 500 Jewish cases. (Dewey, Child, Ruml)

AVERAGE SCORES[3] BY AGE AND SEX

	Sex	Age	9	10	11	12	13
Part I	M	Average	17.88	18.04	18.68	18.98	18.84
		S. D.	2.83	2.55	1.75	1.28	1.78
	F	Average	16.71	17.28	17.45	18.45	18.38
		S. D.	3.81	3.12	3.67	1.85	1.70

	Sex	Age	9	10	11	12	13
Part II	M	Average	4.58	5.61	6.11	6.54	7.82
		S. D.	3.53	3.73	3.21	3.30	2.66
	F	Average	3.20	3.85	4.72	5.39	5.96
		S. D.	3.04	3.48	3.52	3.81	2.76

[1] The authors have substituted symbols for each possible move, *e.g.*, putting axles on cart X and Y; removal of a piece, symbol followed by X; piece incorrectly attached, symbol followed by O. For exact details, *ibid.*, p. 22.

[2] For fuller norms, *ibid.*, pp. 78–79.

[3] Score here is sum of credits obtained. Authors also give norms for time in seconds for Part I, *ibid.*, p. 78.

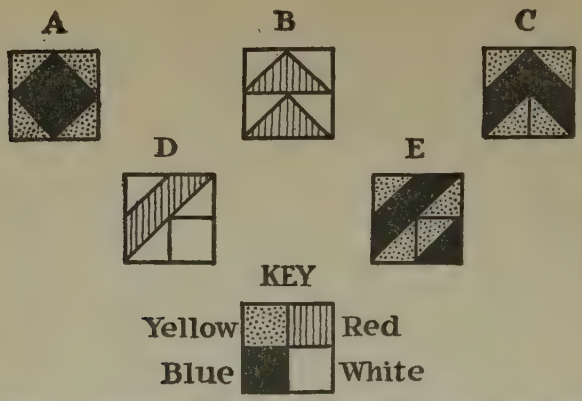


Illustration by courtesy of Lightner Witmer, Editor of the *Psychological Clinic.*

59. COLOR CUBES TEST — MAXFIELD [1]

Material: Eight "Color Cubes." Designs as above.

Directions: [2] Pick up a block and show S its color arrangement, carefully displaying the six sides. Under cover, make Design A with four blocks. Then expose it and tell S to make one exactly like it. Give Designs B and C in a similar way. With Designs D and E tell S that he is to reproduce the design from memory.

Scoring: Time each design separately. Time limit three minutes for each design. For D and E allow exposure of ten seconds. Give only one trial for D; if E is failed allow re-exposure of five seconds.

Norms: [3] 947 cases. (Hutt)

[1] **196**, pp. 98–109.
[2] Hutt, **192**, pp. 77–97.
[3] For fuller norms, *ibid.*, pp. 81–85.

Percentile Score in Seconds

Design	Age	6	7	8	9	10	11	12	13	14
A	80 Percentile	9	10	12	9	10	9	9	12	10
	Median	30	30	30	19	19	15	15	17	17
	20 Percentile	120	75	70	65	40	36	35	38	30
B	80 Percentile	8	12	12	12	13	14	12	14	11
	Median	35	33	35	27	24	21	20	18	18
	20 Percentile	167	78	80	69	45	43	38	36	33
C	80 Percentile	20	25	20	17	17	15	15	14	14
	Median	45	43	35	29	30	27	26	23	20
	20 Percentile	170	93	80	60	67	47	45	39	32
D	80 Percentile	169 to F	160 to F	105	26	19	16	16	17	14
	Median	F	F	F	165 to F	59	44	35	30	32
	20 Percentile	F	F	F	F	F	F	128 to F	180 to F	165 to F
E (1st trial)	80 Percentile	125	60	46	37	21	17	15	17	17
	Median	F	F	F	160 to F	52	35	36	30	38
	20 Percentile	F	F	F	F	F	175 to F	100	105 to F	155 to F

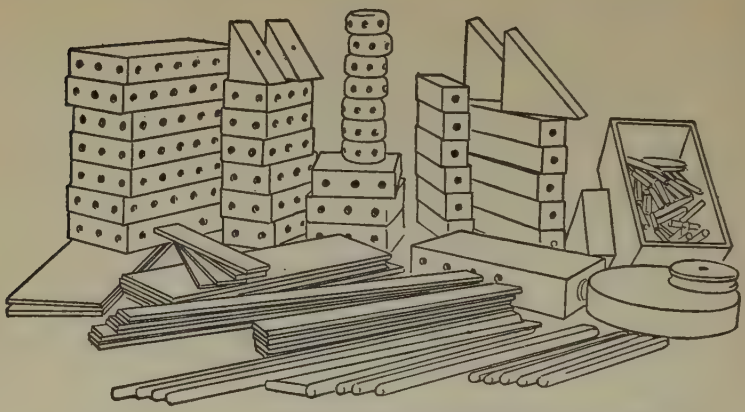


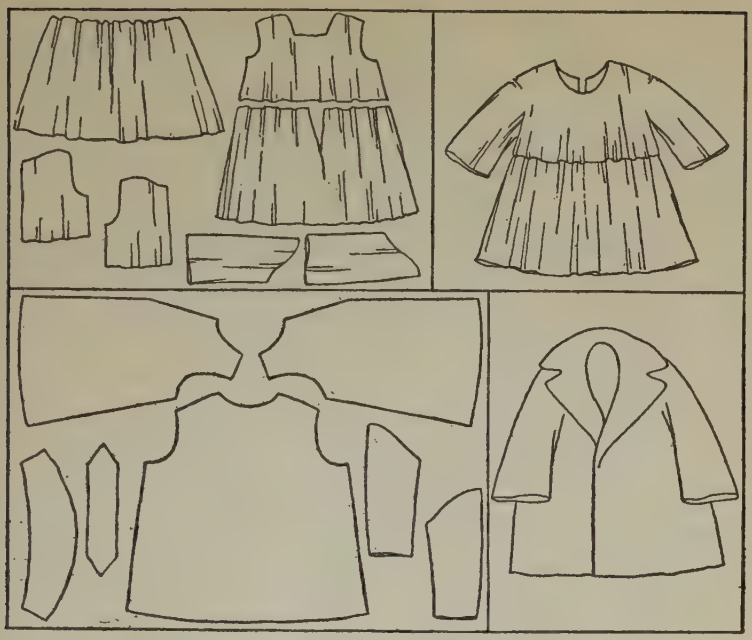
Illustration by courtesy of C. H. Stoelting Co.

60. CONSTRUCTIVE ABILITY TEST — KELLEY [1]

Material: Set of drilled blocks, boards, dowel pins, etc., as above.

Directions, Scoring, and tentative **Norms** supplied with material.

[1] 193, pp. 1–16.



61. FROCK AND COAT TEST — MCFARLANE [1]

Material: Frock for girls, coat for boys, for three-year-olds; each seven pieces fastened with snaps.

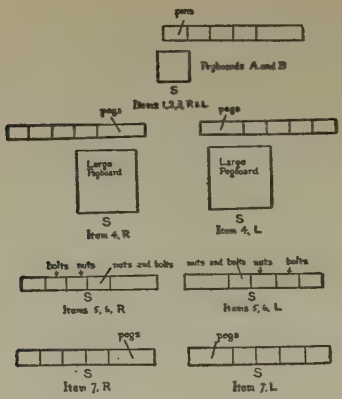
Directions: Tell S to spread out the seven pieces (not allowing him to fasten them together) and see if he can tell what kind of garment they make. If he cannot decide within a few minutes what they make, help him with questions till he reaches the idea. Then tell him to construct the garment.

Scoring: Record time from moment S begins construction.

Norms: [2] 238 English cases. (McFarlane)

Sex	Age	11	14	16
M	Median (minutes)	39	34.6	*29*
	Quartile dev. . .	11.8	9.3	*9.0*
F	Median (minutes)	37	16	*13.6*
	Quartile dev. . .	11.2	7.8	*2.6*

[1] **53**, pp. 21–25; 35–36. [2] For fuller norms, *ibid.*, p. 20; pp. 35–36.



62. MANUAL DEXTERITY SERIES — WHITMAN [1]

Material: Pegboards, two hundred brass pins, Adjusto tray, one hundred colored pegs, twenty bolts, twenty nuts, tray with one large and four small compartments. (Layout illustrated above.)

Directions: (1) Tell S that he is to fill as many holes with pins as possible before time is called. He must use only one hand (the preferred hand) and pick up one pin at a time. Tell him to have a pin in his hand, ready to start. (2) Repeat, S using other hand. (3) Tell S to put three pins in each hole, using both hands and doing it any way he wishes. He is to be ready with three pins in his hand for the first hole. (4) S is told to use his right hand and pick up one peg at a time. He is to put in a red peg, then orange, yellow, green, and purple pegs, being sure to skip a hole between two colors. He is to do as many rows as he can before time is called, being sure always to follow the order as illustrated. He is to have a red peg in his hand ready to start. (Illustrate with 2 rows.) (5) Disassemble two nuts and bolts. Instruct S to take off as many of the remaining eighteen nuts as he can, putting the nuts in one compartment and the bolts in another. He is to take one in his hand ready to start. (6) Assemble two nuts and bolts and instruct S to put together as many of the remaining eighteen as

[1] 198, pp. 118–123.

he can, putting the bolt on far enough so that the top of bolt shows over the nut, and then to put it in the tray. He is instructed to hold a bolt and a nut in his hand ready for the signal. (7) Sort out two pegs of each color into different compartments and tell S to sort as many of the remaining pegs as he can into the compartments in this order: red, yellow, green, purple. He is to use only his right hand.

Scoring: Time limit Items 1 and 2, one minute each; Item 3, two minutes; Item 4, one minute; Items 5, 6, and 7, thirty seconds each. Final score is sum of credits as below:

Item 1 . . . . ½ Number of holes filled (to nearest integer)
Item 2 . . . . ½ Number of holes filled
Item 3 . . . . Number of holes correctly filled
Item 4 . . . . Number of pegs correctly placed
Item 5 . . . . Twice the number disassembled
Item 6 . . . . Twice the number assembled
Item 7 . . . . Number of pegs correctly placed

Norms:[1] 491 cases. (Whitman)

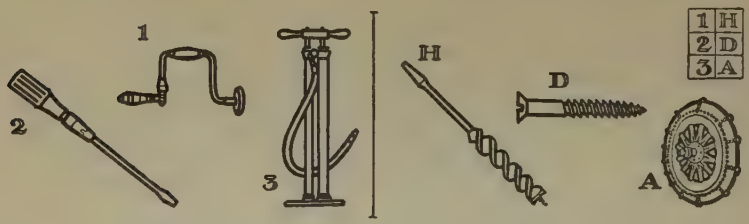
FINAL SCORES BY AGE

Age . . .	7	8	9	10	11	12	13	14	15
75 percentile	*86*	82	91	102	106	112	114	116	*124*
Median . .	*69*	74	82	94	99	102	109	109	*115*
25 percentile	*64*	65	73	84	92	91	99	98	*106*

MEDIAN SCORES FOR SEPARATE ITEMS BY AGE

Age	Items	1	2	3	4	5	6	7
	7	*7.7*	*7.4*	*16.2*	*11.5*	*5.7*	*11.2*	*14.5*
	8	8.0	7.5	17.2	13.5	6.0	11.5	15.6
	9	8.7	7.8	18.2	13.9	7.4	13.4	17.5
	10	9.3	8.4	22.1	19.3	7.7	13.5	18.1
	11	9.4	9.0	22.8	21.4	8.0	14.7	19.9
	12	10.0	9.1	23.9	19.8	9.2	15.7	20.9
	13	10.3	9.3	25.1	21.6	9.7	15.4	21.6
	14	10.1	9.3	25.2	20.0	9.6	16.3	21.9
	15	*10.4*	*9.5*	*26.2*	*23.3*	*11.5*	*16.7*	*24.1*

[1] For fuller norms, *ibid.*, pp. 121–122.



63. MECHANICAL APTITUDE TESTS I AND II — STENQUIST [1]

Material: Test I. Series of ninety-five pictures of common mechanical objects (as illustrated in sample above). In each problem S is required to determine which one of five pictures belongs with each of five others.

Test II. Similar material with questions regarding a machine and its parts, and the mechanical processes in which they are used.

Directions, Scoring, and **Norms** in manual supplied with material.

[1] 197.

64. PAINTED CUBE TEST [1]

Material: [2] (*a*) Model of three-inch cube painted red on all surfaces; (*b*) twenty-seven one-inch cubes, eight painted red on three sides, twelve on two sides, six on one side, and one unpainted.

Directions: [3] Allow S to examine model. When he has looked at every side he is told to build with the twenty-seven small cubes a big cube like the model he has been looking at, "putting all the red paint outside and all the white wood inside."

Scoring: Note method used by S, and record number of attempts made. Test is scored, however, by total time taken to complete the cube.

Norms: [4] 138 English cases. (McFarlane)

Sex	Age	14	16
M	Median (minutes)	16.0	11.0
	Quartile dev.	7.4	4.2
F	Median (minutes)	20.2	14.0
	Quartile dev.	7.8	8.0

[1] Doll, **190**, pp. 176–178.
[2] Also *see* Test 102.
[3] An interesting introduction to this test is Test 110.
[4] For fuller norms *see* **53**, pp. 35–36.

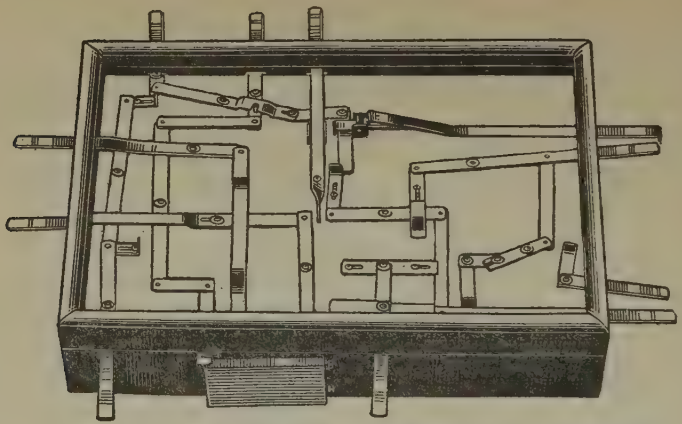


Illustration by courtesy of C. H. Stoelting Co.

65. PUZZLE BOX TEST — FREEMAN [1]

Material: Puzzle box as above.

Directions: Tell S that if he moves the levers correctly the little door in front will spring open. He is told to study the box carefully so that he may move the levers in the right order. He is warned not to use force.

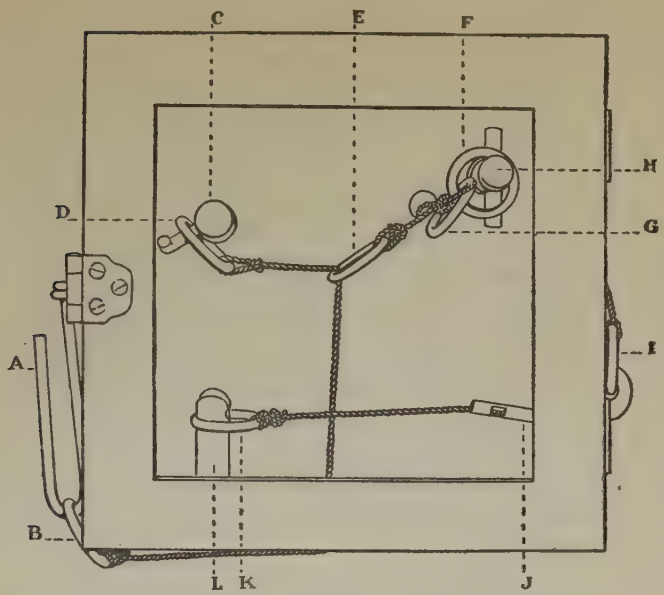
Scoring: Time limit 5 minutes.[2]

Norms: [3] 336 Males. 232 Females. (Woolley)

SCORES IN SECONDS FOR 18-YEAR-OLDS

Sex	75 percentile	50 percentile	25 percentile
M	104.4	177.7	300+
F	176.0	300+	300+

[1] 7, p. 34.
[2] Woolley, 100, p. 147.
[3] For fuller norms, *ibid.*, p. 146.



66. PUZZLE BOX TEST [1] — HEALY-FERNALD-HAYES

Material: Puzzle Box and buttonhook.

Directions: Say to S, " You see that this box opens by the lid lifting up. The glass is put in so that you can see the way to open it. You can work through the holes and use the buttonhook. Study the box, and if you do the right things in the right order, it can readily be opened. Do not break the string or glass. Open it as quickly as you can." If E wishes to carry test further after the box is opened he may say, " Now close it." Note that S is not told beforehand that he is to close the box.

Scoring: Time limit for opening,[2] five minutes; for closing, ten minutes. Record time. Note method of attack and procedure.

[1] Healy, Fernald, 49, pp. 18–21.

[2] To open the box, seven distinct steps are necessary, as follows:

Step 1. Removing ring K from post L.
Step 2. Pulling out staple J.
Step 3. Removing ring I.
Step 4. Removing ring F from post H.
Step 5. Removing ring D from arm of post C.
Step 6. Removing ring B from hook A.
Step 7. Removing hook A and opening box.

Norms:[1] 277 cases. (Shimberg, Lowe, Meehan)

Percentiles	Time — Seconds (for opening)	
	Males	Females
100	57	85
90	90	130
80	121	176
70	145	210
60	161	238
50	199	299
40	230	F
30	299	F
20	F	F
10	F	F
0	F	F

[1] Judge Baker Foundation study as yet unpublished. Ages on which norms are based range from 14½ years to and including adults. Preliminary statistical work determined the fact that this is not an age-level test.

67. TOWER TEST [1]

Material: A nest of seven square boxes covered with brightly colored pictures, varying from $3\frac{1}{2}$ to $2\frac{1}{2}$ inches in size. Each box except the smallest lacks one side.

Directions: Scatter boxes on floor and say, "Build the tallest tower you can with these blocks." When S has completed the performance to his satisfaction, center the tower so that it sits squarely on the floor. Then say, "Now raise the tower and place it on the table without spilling it." If S spills the tower, remove the smallest block and tell him to try again. Repeat this until he succeeds. Then scatter blocks again on the floor and say, "Now pack up the blocks for me to take away."

Scoring: Record time and success on each of the three parts. Part I is passed if S builds tallest possible tower. In Part II record number of boxes removed. In Part III S succeeds if he nests the boxes.

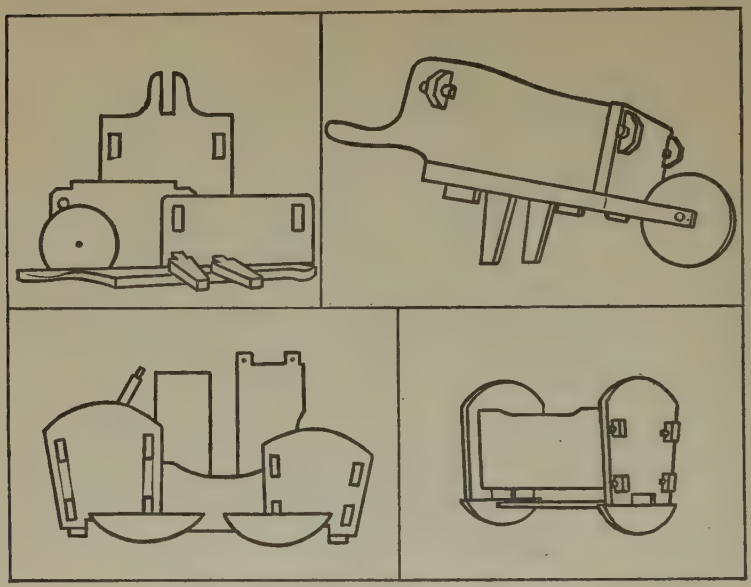
Norms: [2] 728 cases — institutional children. (N. Y. Bureau of Analysis)

Mental Age [3]	*Build* Average Time	*Raise* Average Time	*Removed* Average Number	*Pack* Average Time
VI	49.8	87.9	4	38.9
VII	43.6	72.9	3	33.7
VIII	37.6	73.3	3	28.4
IX	31.0	73.7	2	21.9
X	27.8	57.9	2	19.5
XI	21.5	48.1	1	13.6
XII	21.3	42	1	15.3

[1] N. Y. Bureau of Analysis and Investigation, **40**, pp. 127–132.

[2] For fuller norms, *ibid.*, pp. 131–132.

[3] Mental age determined by Goddard's 1911 revision of the Binet-Simon Measuring Scale of Intelligence.



68. WHEELBARROW AND CRADLE TEST — McFARLANE [1]

Material: The wheelbarrow (for boys) and cradle (for girls) "each consist of eight sections and are made of one-half inch wood. The pieces are fixed together by tongues which fit into slots and are held together by wooden pegs . . . . Both models are about eighteen inches long and stand about eleven inches high."

Directions: Present the eight pieces as above and tell S to spread them out and see if he can tell what kind of toy they make. Allow him to arrange them in any way he wishes without actually fastening them together. If he cannot decide within a few minutes what they make, help him with questions until he reaches the idea. Then tell him to construct the toy.

Scoring: Record time from moment S begins construction.

[1] 53, pp. 21–25, pp. 35–56.

Norms:[1] 238 English cases. (McFarlane)

Sex	Age 11	14	16
M	Median (minutes) 14	12.5	*10*
	Quartile dev. . . 6.25	2.9	*4.0*
F	Median (minutes) 28	14	*10*
	Quartile dev. . . 7.7	5.3	*4.2*

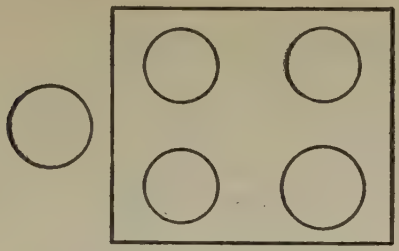
[1] For fuller norms, *ibid.*, p. 20; pp. 35–36. McFarlane presents results from both technical and random groups. The latter only is given above.

CHAPTER 6

Form Board and Construction Board Tests

69. Adaptation Board
70. Arrow Board
71. Casuist Form Board
72. Construction A
73. Construction B
74. Construction Puzzles
75. Cylinder
76. Diagonal
77. Feature Profile
78. Five Figure Board
79. Form Board IA
80. Form Board IC
81. Form Board 3
82. Form Board 4
83. Form Board (Ferguson)
84. Form Board (Seguin-Goddard-Norsworthy)
85. Form Board (Seguin-Witmer-Sylvester)
86. Manikin
87. Mare and Foal
88. Ship
89. Triangle
90. Two Figure Board

For unstandardized tests belonging to this category, see Tests 105, 109, 125.



69. ADAPTATION BOARD TEST — GODDARD [1]

Material: Form board with four circular cut-outs, one larger than the other three. A circular block fitting larger hole.[2]

Directions: Holding the board so that the large hole is at the upper right-hand corner, E shows S that the block will fit into only one of the four holes. S is then asked to fit in the block and if he fails, procedure is demonstrated. Then E says, "Watch closely," and the same procedure is followed for the four different positions of the large hole. In the first, the board is turned over so that the hole is at the upper left-hand corner; in the second the board is turned over so that the hole is at the lower left-hand corner; in the third the hole occupies the lower right-hand corner. For the last trial the board is turned toward the child diagonally so that the large hole is at the upper left-hand corner. Each shift of board should take about one-half second.[3]

Scoring: Record number of moves correctly made, including demonstration.

Norms: [4] 827 cases. (Pintner, Paterson)

	Age . . .	5	6	7	8	9	10	11	12	13
Moves	75 percentile	3	5	5	5	5	5	5	5	5
	Median . .	2	4	4	5	5	5	5	5	5
	25 percentile	1	2	3	4	4	4	4	5	5

[1] **205**, pp. 182–188. Also *see* **204**.

[2] It is to be noted that the board used by Pintner, Paterson is of slightly different dimensions than that used by Goddard. Both boards are available.

[3] Pintner, Paterson, **57**, pp. 65–67.

[4] For fuller norms, *ibid.*, pp. 135–136; p. 198.

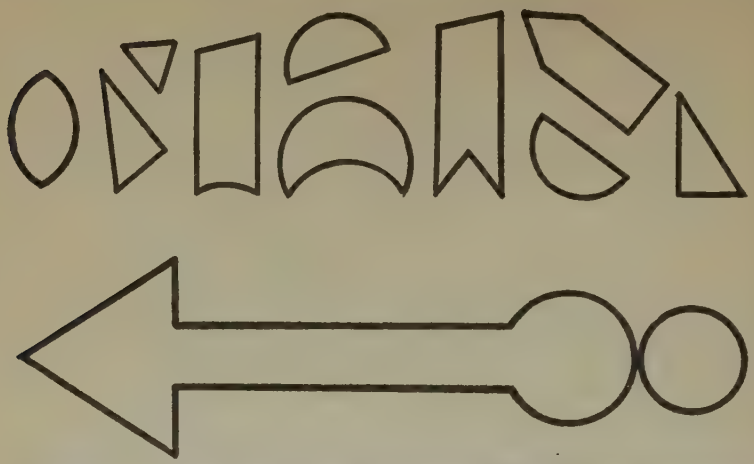


Illustration by courtesy of Carl Murchison, Editor of the *Pedagogical Seminary*.

70. ARROW BOARD TEST — DUNHAM [1]

Material: Board with arrow-shaped cut-out and ten pieces.

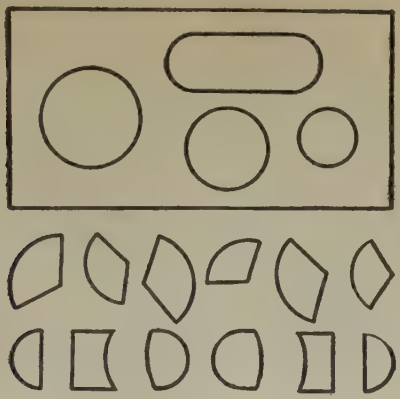
Directions: Place board before S with blocks in three piles above board, no block being near its appropriate recess. Say, " Fit these blocks into the board. If you place them correctly, they go in very easily and if a block almost fits, but not quite, you may know at once that you have made a mistake. Now begin." First trial is intended to enable S to learn the problem. For second and third trials, say, " Do it now as quickly as you can. I will keep account of the time. Ready."

Scoring: During first trial, record " insight, coördination, poise, and use of one or both hands ",[2] also comparative difficulties of each block. For second and third trials, record time in seconds. Score, or time index, is average of second and third trials.

Norms: [3] 184 high school juniors and seniors. (Dunham)

The mean time index is 35.7 seconds. The average scores of boys and girls from fifteen to eighteen years range from 30.8 to 40.2 seconds with a mean variation of 8.5 seconds.

[1] **202**, pp. 283–289. [2] *Ibid.*, p. 286. [3] For fuller norms, *ibid.*, p. 287.



71. CASUIST FORM BOARD TEST [1] — KNOX

Material: Board [2] and twelve pieces.

Directions: Place before S board and pieces as illustrated above. Say, "Put these pieces together as quickly as possible."

Scoring: Record time and number of errors. Time limit five minutes.

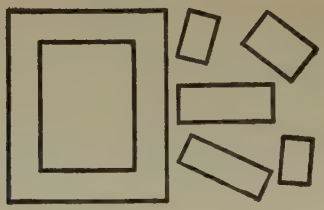
Norms: [3] 918 cases. (Pintner, Paterson)

	Age	5	6	7	8	9	10	11	12	13	14
Time (seconds)	75 percentile .	*212*	143	93	72	69	59	53	53	*57*	*47*
	Median . .	*F*	300	154	106	93	78	68	66	*75*	*58*
	25 percentile	*F*	F	274	165	185	128	99	104	*108*	*84*
Errors	75 percentile	*27*	11	7	4	3	3	3	2	*2*	*1*
	Median . .	*F*	30	12	8	7	5	5	4	*3*	*3*
	25 percentile	*F*	F	30	15	15	12	8	7	*6*	*6*

[1] **247**, pp. 741–747; Pintner, Paterson, **57**, pp. 37–40.

[2] It is to be noted that the board sold by the dealers has not the same dimensions as that on which the norms are based.

[3] For fuller norms *see* **57**, pp. 112–114; pp. 191–192.



72. CONSTRUCTION TEST A[1] —
HEALY-FERNALD-FREEMAN

Material: Frame and five rectangular pieces.

Directions: Expose frame with pieces outside, being careful that they are not seen in the correct relationship for placing. Keep frame with narrower sides top and bottom. Say, "Here is a frame and here are five pieces. If you put them in correctly they will fill the frame exactly without leaving space. See how quickly you can get them in."

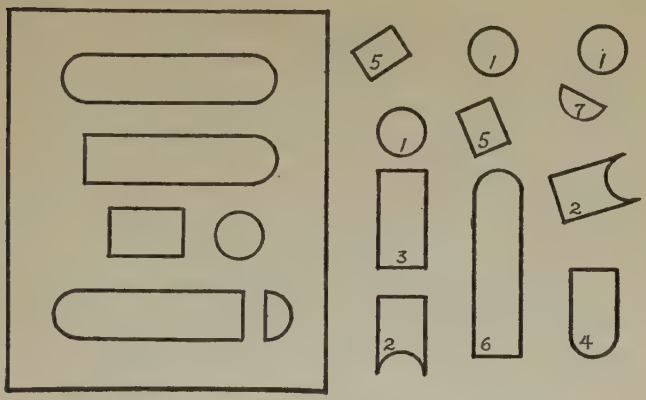
Scoring: Record number of moves and time in seconds. Time limit five minutes. Moves may be scored as follows:

1. Placings which either are correct or which at first trial seem immediately to offer a correct solution.
2. Obviously impossible placings, *i.e.* placings clearly wrong, or attempted placings where pieces will not go in.
3. Repetition of impossibilities, *i.e.* of errors already made, obvious impossibilities or apparent possibilities previously found wrong.

Norms:[2] 1596 cases. (Lowe, Shimberg, Wood)

	Age . . .	9	10	11	12	13	14	15	16	17
Time (seconds)	75 percentile	*46*	31	30	24	22	20	15	15	12
	Median . .	*92*	94	81	63	44	40	29	32	18
	25 percentile	*F*	180	188	131	99	102	71	73	33
Moves	75 percentile	*13*	11	9.5	10.5	7	7	7	6	6
	Median . .	*21*	25	22	18	14	12	10	11	8
	25 percentile	*F*	37	38	32	25	43	20	20	11

[1] Healy, Fernald, **49**, pp. 14–15.
[2] For fuller norms *see* **208**, pp. 324–338.



73. CONSTRUCTION TEST B [1] —

HEALY-FERNALD-DEARBORN

Material: Form board and eleven pieces.

Directions: Present pieces, scattered at side of board, as above. Say, "Here is a board with some pieces which, if they are put in correctly, will exactly fill these spaces (pointing to spaces). See how quickly you can fit them all in."

Scoring: Record time in seconds and total number of moves. Time limit five minutes. On sheet of paper with prepared outline of spaces a record may be made of the placings by number, the number indicating the piece placed, and the exponent the serial order of the move, *e.g.* 6^{3} is piece six and the third move made. Removal of a piece is recorded as follows: $\not{6}^{3}$

Give only one trial. Do not show correct solution or allow work for longer time.

Norms: [2] 1596 cases. (Lowe, Shimberg, Wood)

	Age	9	10	11	12	13	14	15	16	17
Time (Seconds)	75 percentile	*111*	85	81	69	56	60	60	50	46
	Median	*255*	248	132	169	106	103	116	93	80
	25 percentile	*F*	F	F	F	300	226	222	209	145
Moves	75 percentile	*15*	18	15	15	14	14	15	13	13
	Median	*33*	32	23	23	20	20	21	18	17
	25 percentile	*F*	F	F	F	38	30	32	27	25

[1] Healy, Fernald, **49**, pp. 16–17. [2] For fuller norms *see* **208**, pp. 324–338.

74. CONSTRUCTION PUZZLES TEST — WOOLLEY [1]

Material: Nine small stone blocks (making up the "egg of Columbus"). Six frames in the following shapes: egg, flower-pot, chick, ship, cradle, seal.

Directions: Present frame, (egg and flower-pot for age sixteen years; chick and ship for seventeen years, and cradle and seal for eighteen years), and pieces in random order. Tell S that if all the pieces are put in correctly they will fill the frame exactly. He is to fit them in as quickly as possible.

Scoring: Record time. Time limit five minutes.

Norms: [2] 1432 Males. 1212 Females. (Woolley)

Sex		*Egg*	*Flower Pot*	*Chick*	*Ship*	*Cradle*	*Seal*
	Per-centiles	Age 16	16	17	17	18	18
M	75	225.0	40.6	82.1	85.5	155.4	230.7
	50	300 +	58.8	158.7	176.7	291.1	300 +
	25	300 +	91.5	300 +	300 +	300 +	300 +
F	75	267.0	46.3	100.4	96.8	178.7	245.3
	50	300 +	69.9	176.0	202.9	300 +	300 +
	25	300 +	120.0	300 +	300 +	300 +	300 +

[1] 100, pp. 138–141.
[2] For fuller norms, *ibid.*, p. 140, p. 191.

Figure 1

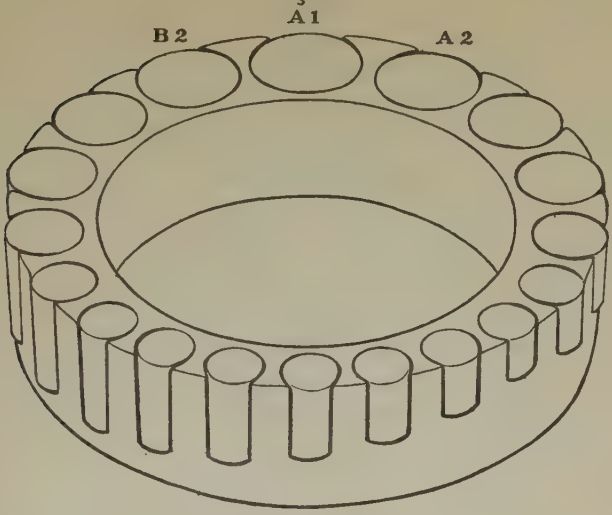
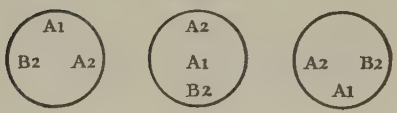


Figure 2



75. CYLINDER TEST [1] — WITMER

Material: Circular board "having a series of recesses about its outer edge into which are fitted eighteen cylinders" differing in depth and diameter. "There is a central compartment into which blocks may be thrown and mixed." [2]

Directions: [3] Place board before S with small cylinders next to him, and all pieces in place. There are three trials given and four steps to each trial, if necessary. (*Step I*) Say, "I am going to take these blocks out and place them in the center and I want you to put them in as quickly as you can." Toss them into the center, small ones first, taking from both sides at the same time. (The large cylinders will then be on top. The rela-

[1] Paschal, **209**, pp. 54–59; Paschal, **210**, pp. 5–54.
[2] Paschal, **209**, p. 55.
[3] Paschal, **58**, pp. 14–19.

tive position of the three large cylinders varies in the three trials. See Figure 2.) Then say, "You may use both hands. Do it as quickly as you can." *No hints* and no answers to questions are allowed. (*Step II*) "Is that all right?" (*Step III*, if S does not correct errors) "That is not right." (*Step IV*, if errors are still not corrected) "Fix it so they will be level with the top." If this is not enough, rub hand over correct cylinders to show that they are level and point to an incorrect one, asking that it be placed correctly.

Second Trial: "Now I am going to take them out and see if you can put them in more quickly this time."

Third Trial: "Now once more."

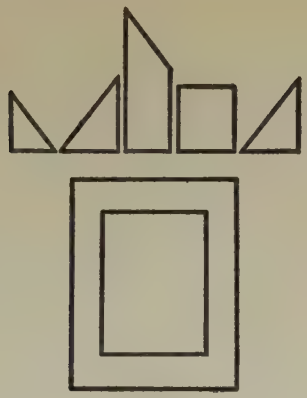
Scoring: Time each step. Time limit of each trial five minutes. Final score is total time on shortest trial.

Norms:[1] 2230 cases. (Paschal)

TIME IN SECONDS FOR THE SHORTEST TRIAL

Sex	Age	6	7	8	9	10	11	12	13	14	15	Adult
M	80 percentile .	69	58	50	43	41	37	35	32	33	*33*	28
	Median . . .	F	76.0	63.5	52.9	49.8	43.5	41.6	37.7	39.7	*37.3*	33.5
	20 percentile .	F	F	88	72	59	55	51	46	46	*44*	40
F	80 percentile .	*77*	65	55	47	42	40	37	36	36	*35*	28
	Median . . .	*F*	89.0	68.0	58.9	50.5	49.7	44.5	42.3	42.2	*42.4*	33.2
	20 percentile .	*F*	F	101	74	67	58	54	53	51	*56*	42

[1] For fuller norms, *ibid.*, p. 31.



76. DIAGONAL TEST [1] — KEMPF

Material: Frame and five pieces.

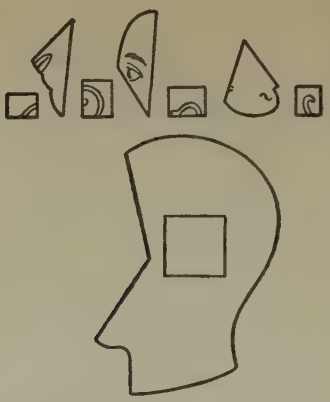
Directions: Place before S, board with narrow edge next to S and the pieces arranged as above. Say, "Put these together as quickly as possible."

Scoring: Record time and number of errors, *i.e.*, such placings as would make the filling in of the rest of the pieces impossible. Time limit five minutes.

Norms: [2] 619 cases. (Pintner, Paterson)

	Age . . . 5	6	7	8	9	10	11	12	13
Time (Seconds)	75 percentile *100*	51	45	29	25	27	31	20	*17*
	Median . . *275*	150	75	76	49	42	54	54	*25*
	25 percentile *F*	F	174	200	141	83	135	116	*49*
Errors	75 percentile *8*	7	5	4	2	2	3	2	*2*
	Median . . *23*	14	9	9	6	6	9	7	*4*
	25 percentile *F*	F	22	27	17	11	20	15	*6*

[1] Pintner, Paterson, **57**, pp. 42–43.
[2] For fuller norms, *ibid.*, pp. 119–122; 193–194.



77. FEATURE PROFILE TEST [1] — KNOX-KEMPF

Material: One large board and seven small pieces which when fitted together form the profile of a head.

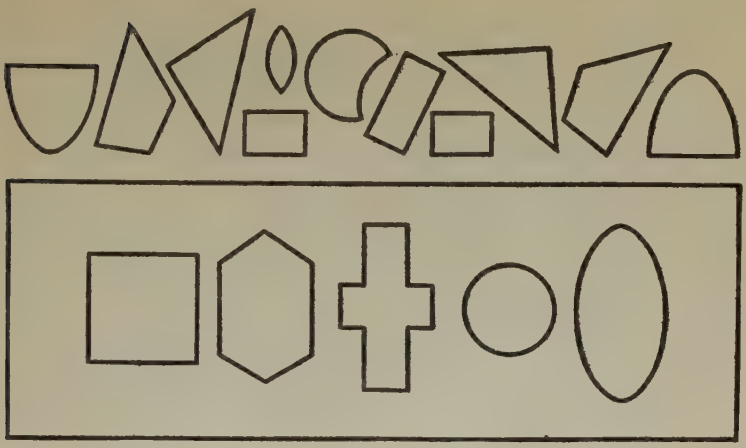
Directions: Present board and pieces as illustrated above. Do not give the test in the large board in which the pieces come. Say, " Put this together as quickly as you can." If S alters the position of the head, do not change it back or help him in any way. *Do not tell S what the board represents.*

Scoring: Record the time for completely accurate performance. Record as failure if S is satisfied with inaccurate performance, *i.e.*, if pieces of ear are not correctly in place.[2] Time limit five minutes.

Norms: [3] 713 cases. (Pintner, Paterson)

	Age . . .	6	7	8	9	10	11	12	13	14	15	16
Time (Seconds)	75 percentile	*F*	F	241	239	134	99	99	90	75	*104*	*68*
	Median . .	*F*	F	F	F	240	157	170	150	132	*150*	*110*
	25 percentile	*F*	F	F	F	F	237	300+	299	212	*300+*	*190*

[1] Knox, **247**; Pintner, Paterson, **57**, pp. 55–58.
[2] From letter to authors.
[3] For fuller norms *see* **57**, pp. 128, 196.



78. FIVE FIGURE BOARD TEST [1] — PATERSON

Material: Board and 11 pieces.

Directions: Place before S, board and pieces as shown above. Say, "Put this together as quickly as possible."

Scoring: Record time and note errors in placing. Time limit five minutes.

Norms: [2] 933 cases. (Pintner, Paterson)

	Age . . 5	6	7	8	9	10	11	12	13	14
Time (Seconds)	75 percentile 139	112	80	67	56	49	48	43	35	*45*
	Median . F	200	117	97	79	69	64	58	47	*59*
	25 percentile F	F	225	146	132	107	91	85	63	*80*
Errors	75 percentile 11	5	4	3	2	2	2	1	1	*2*
	Median . F	14	7	6	4	4	4	3	3	*3*
	25 percentile F	F	19	12	8	7	6	6	5	*6*

[1] Pintner, Paterson, **57**, pp. 34–35.
[2] For fuller norms, *ibid.*, pp. 105–107; 189, 190.

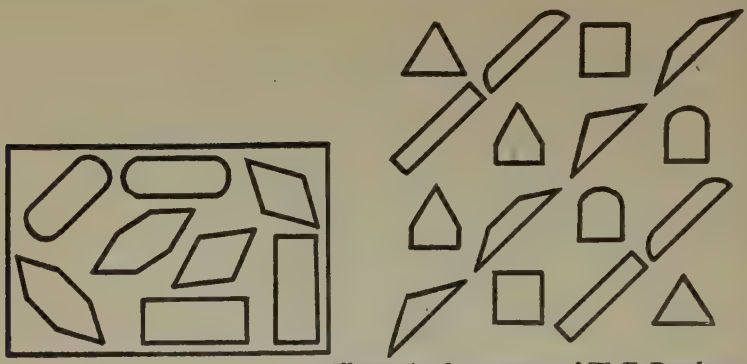


Illustration by courtesy of W. F. Dearborn.

79. FORM BOARD 1 A TEST [1] — DEARBORN-ANDERSON

Material: Board and sixteen pieces.

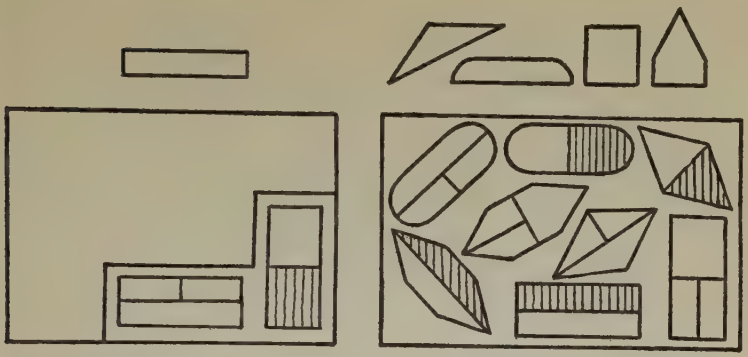
Directions: Present board as above and blocks in four piles. (In diagram above, the upper row represents the top block of each of the four piles and the bottom row the bottom block, etc.) Tell S that each empty space may be filled by two blocks. He is to put them in as quickly as possible.[2]

Scoring: Time limit five minutes. Record right moves (*i.e.*, block placed where it will fit) and wrong moves (*i.e.*, attempt to place block where it will not fit). If blocks are fitted together outside board, count two moves when double block is fitted in. Final score for moves is sum of right and wrong moves. For " performance age " (in terms of seconds taken) add one year if S takes from six to eighteen moves, subtract one year if S takes twenty-four or more moves.

Norms: [3] 433 cases. (Dearborn, Shaw, Lincoln)

Age	5	6	7	8	9	10
Median Moves	*20*	18.9	19.4	19.0	*19.9*	*20*
Median Seconds	*197.5*	189.0	133.1	119.5	*121.2*	*115.0*
Performance Age in Seconds . . .	210	195	165	125	115	

[1] Dearborn, Anderson, Christiansen, **200**, pp. 448–450; Dearborn, Shaw, Lincoln, **201**, pp. 20–22.
[2] Dearborn, Shaw, Lincoln, **201**, p. 22.
[3] For fuller norms, *ibid.*, pp. 40–42.



Shaded parts indicate unfilled spaces

Fig. 1 Fig. 2

Illustration by courtesy of W. F. Dearborn.

80. FORM BOARD 1 C TEST [1] — DEARBORN-ANDERSON

Material: Form board 1 A and twelve of the same blocks used in Test 79, each of the four remaining blocks being halved as illustrated above. Cardboard shield.

Directions: Present board partially shielded and rectangular block as in Figure 1 above. Tell S that he is to change the blocks around in such a way that he can fit in the long block and both empty spaces will be filled. Demonstrate solution, if necessary, at the end of thirty seconds. Present board and pieces as shown in Figure 2. Tell S to fill in all the spaces as quickly as he can, moving the blocks around, and using the blocks at the top of the board. He is to work as quickly and with as few moves as possible.[2]

Scoring: Record time and moves as in Test 79. For " performance age " (in terms of minutes taken) add one year if S takes only twelve to fifteen moves.

Norms: [3] 433 cases. (Dearborn, Shaw, Lincoln)

[1] Dearborn, Anderson, Christiansen, **200**, pp. 448–450; Dearborn, Shaw, Lincoln, **201**, pp. 22–23.

[2] Dearborn, Lincoln, **201**, p. 23.

[3] For fuller norms, *ibid.*, pp. 43–45.

Age . . .	5	6	7	8	9
Median moves	F	26.5	19.9	20.5	19.5
Median seconds	F	300	249.2	247.0	200.5

Performance Age	6 or less	7 to 8	9 or above
Minutes . . .	F	4–5	3–4

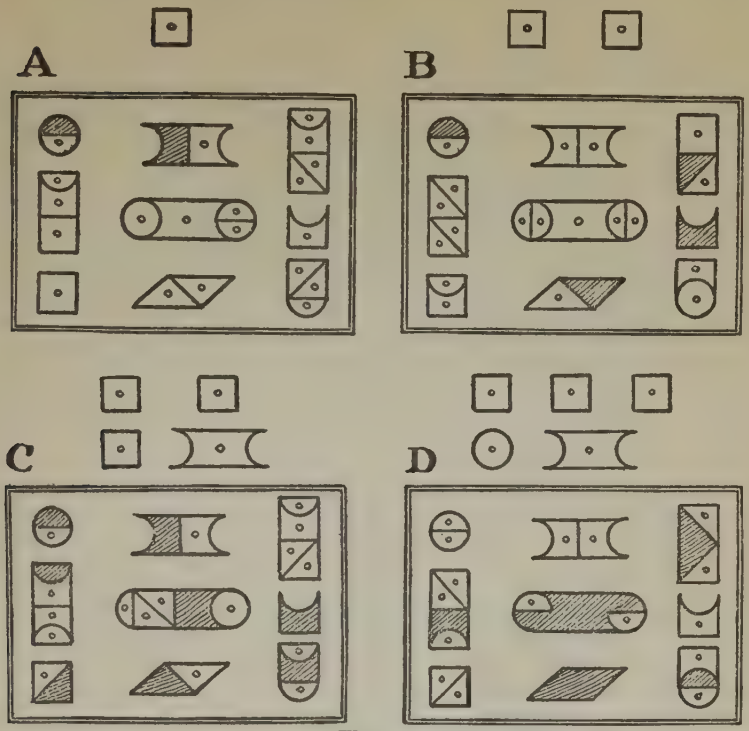


Illustration by courtesy of W. F. Dearborn.

81. FORM BOARD 3 TEST [1] — DEARBORN

Material: Form board and twenty-one blocks arranged successively in four ways as above.

Directions: Present problem A and say, "I am going to show you how to fit all these pieces in and then I am going to give you another problem to see if you can do it yourself." E then demonstrates solution, explaining procedure. Problem B is then presented (board is always hidden from S during rearrangement), and S is told to fill every space and put every block in the board in as short a time and with as few moves as

[1] Dearborn, Anderson, Christiansen, **200**, pp. 453–455; Dearborn, Shaw, Lincoln, **201**, pp. 26–29.

possible. Give problem D and then problem C in similar manner.[1]

Scoring: Record time and total number of moves for each problem. If unsolved in five minutes, record as incomplete. Count as a move any attempt to place a block in the board, whether it fits (correct move) or it fails to fit (incorrect move). For " performance age " (in terms of total moves taken) add one year if total time taken for the three problems is four minutes or less. If " performance age " is eight or above and total time is over five and one half minutes, subtract one year; if over six and a half minutes subtract two years. (When a problem is failed, count time as three hundred seconds and moves as thirty.)

Norms:[2] 362 cases. (Dearborn, Shaw, Lincoln)

MEDIANS OF TOTAL MOVES AND TIME BY AGE

Age	6	7	8	9	10	11	12	13	14
Moves	*47.5*	45.2	43.3	*39.4*	*36.5*	35.5	*33.3*	*36.9*	—
Time	*390*	345	268	*249*	*263*	246	*206*	*273*	—
Performance Age in Moves	48	45	42	39	36	34	32	28 to 31	22 to 27

[1] Experimentally it has been proved that problem C is more difficult than problem D.

[2] For fuller norms *see* **201**, pp. 46–55.

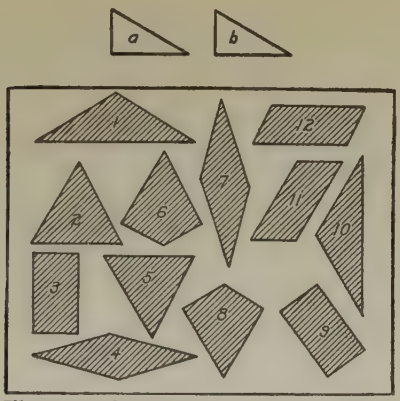


Illustration by courtesy of W. F. Dearborn.

82. FORM BOARD 4 TEST[1] — DEARBORN

Material: Board and two triangles.

Directions: Tell S that the two triangles fill each space. E fills depression 1 and then replaces blocks above the board. S is instructed to put the triangles in the first space as quickly as possible. If he is unsuccessful at the end of one minute E demonstrates solution again. S is then told to take the blocks out of space 1 and put them into space 2, and then 3, etc. As each hole is completed E urges S on to next hole. S may be helped with depression 2 as on depression 1 above, but never subsequently. S may be encouraged to try blocks in some other way, to turn them around, etc. He is never allowed to match them in the air.

Scoring: Time limit ten minutes. Record time from moment S begins to fill depression 2 until he completes the test, including possible demonstration time of No. 2.

Norms:[2] 106 cases. (Dearborn, Shaw, Lincoln)

Age	7	8
Median seconds	260	*220*

[1] Dearborn, Shaw, Lincoln, **201**, pp. 29–32. This is a modification of the *Triangle Performance Test* reported by Dearborn, Anderson, Christiansen, **200**, p. 455.

[2] For "tentative standards" *see* **201**, pp. 55–56.

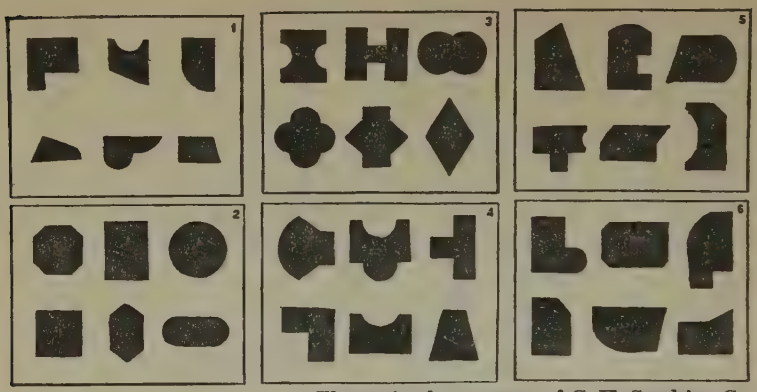


Illustration by courtesy of C. H. Stoelting Co.

83. FORM BOARD — FERGUSON [1]

Material: Six graded form boards, each containing six spaces. Each space is filled by *one* block in the first board and by *two* in the other five boards. In boards 3, 5, and 6, the blocks fit together by beveled edges, in board 4 by double bevel and groove.

Directions: [2] Give boards in order I to VI as above, or until S has failed two consecutive boards. Present pieces outside the board in such a way that no two blocks belonging together are in juxtaposition. Turn over pieces as below:

Board I.	Turn over the middle block in the upper row and the two side blocks on the lower row.
Board II.	No turning over is necessary.
Board III.	Turn over one of each pair so that the larger part of each block is uppermost, the bevels thus being hidden.
Board IV.	Turn over one of each pair.
Board V.	Turn over the smaller of each pair.
Board VI.	Turn over one of each pair so that the larger part of the block is uppermost.

The removal and the turning of the pieces is always done out of sight of S. Say to S, "Put these pieces in as quickly as you can."

[1] **203**, pp. 47–58.

[2] The method and scoring described here are in use at the Judge Baker Foundation. J. S. Plant was chiefly instrumental in modifying the original Ferguson directions.

Scoring: Record time for each board. Time limit for each board is five minutes. (If failure on any board, record number of pieces correctly placed.)[1] Convert seconds into values according to table below. Final score is sum of all the values.

Values		10	9	8	7	6	5	4	3	2	1	0
Board I	Time in Seconds.	0 to 16	17 to 19	20 to 21	22 to 24	25 to 27	28 to 29	30 to 36	37 to 51	52 to 66	67 to 300	F
Board II		0 to 68	69 to 72	73 to 76	77 to 81	82 to 86	87 to 89	90 to 92	93 to 97	98 to 104	105 to 300	F
Board III		0 to 79	80 to 88	89 to 95	96 to 102	103 to 112	113 to 127	128 to 144	145 to 163	164 to 186	187 to 300	F
Board IV		0 to 117	118 to 130	131 to 140	141 to 155	156 to 178	179 to 197	198 to 205	206 to 208	209 to 212	213 to 300	F
Board V		0 to 167	168 to 181	182 to 197	198 to 216	217 to 232	233 to 242	243 to 253	254 to 264	265 to 271	272 to 300	F
Board VI		0 to 223	224 to 248	249 to 262	263 to 267	268 to 269	270 to 272	273 to 277	278 to 285	286 to 294	295 to 300	F

Norms:[2] (tentative) 308 males, 171 females. (Meehan, Shimberg)

SMOOTHED SCORES BY SEX AND AGE

Sex	Age 9	10	11	12	13	14	15	16
M	*12*	*18*	*24*	*30*	*36*	*42*	*48*	54
F	—	—	—	—	—	*34*	*38*	41

[1] We believe that this will augment the discriminative value of the scores. To date, however, it has not been taken into account.

[2] Part of the data has been supplied by J. S. Plant.

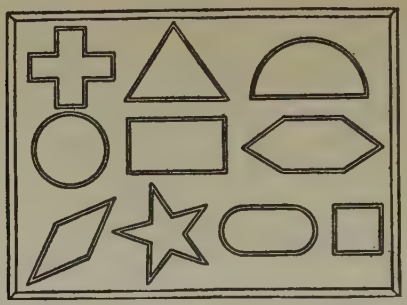


Illustration by courtesy of C. H. Stoelting Co.

84. FORM BOARD TEST — SEGUIN-GODDARD-NORSWORTHY [1]

Material: Form board and ten geometrical figures.

Directions: [2] *First trial:* S stands before table with side of form board containing star nearest him. Quickly remove blocks and throw them indiscriminately into a compact pile near edge of the form board at S's right, S watching the removal. Then say, "Put the blocks back into their proper places just as fast as you can. Use only one hand."

Second trial: Repeat directions and say, "Try to do it faster this time."

Third trial: Repeat directions and say, "Try to do it still faster this time." [3]

Scoring: Record time for each trial. Final score is average of three trials. For a qualitative picture of performance, Wallin suggests the following scheme: Each recess and the block filling it are given corresponding numbers. For correct placement, record number followed by a period (*i.e.*, 6.). If block is placed in incorrect recess put — after block and before recess number. If block is manipulated but not correctly placed put — 0 after number. If block is left above recess, indicate by X. Vertical line through number indicates block removed but not replaced.[4]

[1] Norsworthy, **89**; Goddard, **205**, pp. **49–52**.

[2] Wallin, **215**, pp. 12–14.

[3] For a description of the tactual rather than the visual method *see* Whipple, **66**, pp. 300–304; Sylvester, **212**, pp. 10–12.

[4] **215**, pp. 13–14.

Norms:[1] **1345 cases. (Wallin)**

Sex	Age	5	6	7	8	9	10	11	12	13	14
M	Average (Seconds)	*30.94*	26.19	22.52	19.53	17.19	15.97	14.57	13.79	13.98	12.95
F	Average (Seconds)	*33.82*	26.84	23.14	18.89	18.59	16.40	15.80	14.25	14.24	*13.34*

[1] For fuller norms *see* **213**, pp. 385–386.

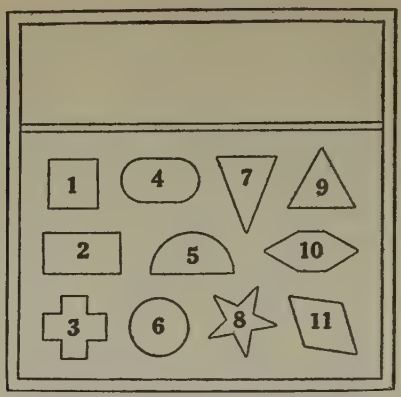


Illustration by courtesy of Lightner Witmer, Editor of the *Psychological Clinic.*

85. FORM BOARD TEST [1] — SEGUIN-WITMER-SYLVESTER

Material: Form board and eleven geometrical figures similar to Test 84, but smaller in size.

Directions: [2] Keep board with tray on farther side, as above. Give three trials. For first trial, place blocks haphazardly in tray, saying, "I'm going to take these blocks out and put them up here. I want to see how quickly you can put them back where they belong." For second trial, arrange blocks in three piles, with Pile I to the left, containing from top to bottom, pieces 5, 10, 7, and 8; Pile II, pieces 11, 2, and 9; and Pile III, pieces 1, 6, 4, and 3. Permit S to watch removal of blocks in first and second trials. On third trial S is allowed to take blocks out and place them in tray. On all three trials allow S to use both hands and encourage him to work as quickly as possible.[3]

Scoring: Time each trial separately. Score may be either in terms of (1) time of first trial in seconds, or (2) time of shortest trial in seconds.

[1] Witmer, **216**, pp. 247–249.

[2] For a slightly different procedure in giving this test together with adequate norms *see* Sylvester, **212**.

[3] (*a*) Young, **219**, pp. 85–87; (*b*) Young, **218**, pp. 97–100.

Norms:[1] (*a*) 1793 Males, 1691 Females. (Young)
(*b*) 845 Males, 802 Females. (Young)

(*a*) First Trial Median Scores

Age in half-year periods

Sex	Years	5	5	6	6	7	7	8	8	9	9	10	10
	Months	0–5	6–11	0–5	6–11	0–5	6–11	0–5	6–11	0–5	6–11	0–5	6–11
M	80 %ile	52	41	38	34	33	30	28	26	24	22	22	20
	Median	73	60	50	47	44	39	34	32	30	28	26	25
	20 %ile	113	93	91	65	57	52	52	45	39	37	32	33
F	80 %ile	*57*	42	45	38	35	33	28	26	25	21	22	22
	Median	*86*	61	60	51	45	45	33	35	31	27	27	28
	20 %ile	*F*	102	117	90	62	60	41	44	41	39	36	32

Age in year periods

Sex	Age	11	12	13	14	15	adult
M	80 %ile	21	19	18	17	*17*	16
	Median	25	24	22	21	*21*	19
	20 %ile	31	30	26	28	*27*	23
F	80 %ile	22	20	19	19	*18*	15
	Median	25	25	23	22	*22*	18
	20 %ile	32	31	29	28	*31*	22

(*b*) Average Time of Shortest of Three Trials

Sex	Age	6.25	7.25	8.25	9.25	10.25	11.25	12.25	13.50	14.50	Ad.
M	Average	*31.4*	27.5	24.5	20.9	19.4	17.7	16.1	15.2	14.5	11.8
	S. D.	*8.29*	5.41	5.01	4.70	4.28	3.47	3.56	3.23	3.00	2.96
F	Average	34.8	28.1	23.5	21.5	18.3	17.8	17.0	16.6	16.0	12.3
	S. D.	11.21	7.41	4.94	5.48	3.39	3.68	3.76	3.61	3.53	2.72

[1] For fuller norms *see* (*a*) **219**, p. 90; (*b*) **218**, pp. 104–106.

86. MANIKIN TEST [1] — PINTNER

Material: Six wooden pieces representing a conventional figure of a man.

Directions: Place pieces as illustrated above. Say, "Put this together as quickly as you can." S is not told that pieces represent a man.

Scoring: [2] Record time. Time limit five minutes. Score as follows:

Perfect performance	5 points
One or both arms up or out, *i.e.*, not exactly fitting in the joints	4 points
One reversal, *i.e.*, right arm for left arm and vice versa or right leg for left leg	3 points
Two reversals, *i.e.*, both arms and both legs reversed	2 points
Legs or arms interchanged or arms at sides or any other result that looks like a man	1 point
Failure to see that it is a man	0 points

Norms: [3] 545 cases. (Pintner, Paterson)

Age	4	5	6	7	8	9	10
75 percentile	*2*	4	5	5	5	5	*5*
Median	*1.5*	3	4	4	5	5	*5*
25 percentile	*0*	2	3	4	4	4	*4*

[1] Pintner, Paterson, **57**, pp. 53–55.
[2] *Ibid.*, pp. 54, 55.
[3] For fuller norms, *ibid.*, pp. 127, 195.

87. MARE AND FOAL TEST — HEALY-FERNALD [1]

Material: Picture puzzle representing animals in a field.[2]

Directions: [3] Place before S board and pieces in random order. Say, "Put these pieces in the right places as quickly as you can, trying not to make any mistakes." [4]

Scoring: Record time and errors. Time limit five minutes. Any attempted placement, which is incorrect, is counted an error.

Norms: [5] 621 cases. (Pintner, Paterson)

	Age	5	6	7	8	9	10	11	12	13
Time (Seconds)	75 Percentile	*75*	55	41	38	32	31	27	27	*24*
	Median	*107*	71	62	48	41	36	34	35	*29*
	25 Percentile	*160*	92	77	59	49	45	40	60	*33*
Errors	75 Percentile	*5*	2	1	1	1	0	1	1	*1*
	Median	*7*	3	3	2	2	1	2	2	*1*
	25 Percentile	*11*	5	5	3	3	3	3	3	*2*

[1] **49**, pp. 11–13.

[2] The board with which these norms were established was modified by Pintner and Paterson. The four geometrical pieces are glued into place.

[3] This test was used by the originators merely as an introduction to invoke interest.

[4] Pintner, Paterson, **57**, pp. 26–29.

[5] For fuller norms, *ibid.*, pp. 99–102; p. 188.

88. SHIP TEST [1] — GLUECK

Material: A frame and ten colored pieces, forming the picture of a ship.

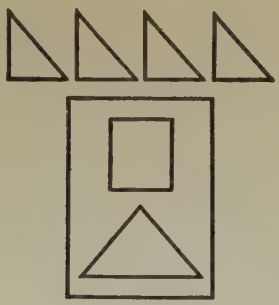
Directions: Place before S board and pieces in random order. Say: "Put this together as quickly as you can." Allow S to continue work as long as he shows any sign of completing the test.

Scoring: Record time. Score is in terms of placings, as follows: two points for each piece in its correct position; one point for each lower or upper piece placed in proper portion; one point for each piece correctly placed in relation to another piece.

Norms: [2] 648 cases. (Pintner, Paterson)

Age . . .	5	6	7	8	9	10	11	12	13	14
75 percentile .	*10*	17	18	18	19	20	20	20	20	20
Median . .	*0*	15	15	17	18	18	19	20	*20*	*18*
25 percentile .	*0*	8	9	15	16	17	18	18	*18*	*17*

[1] Knox, **247**, pp. 741–747; Pintner, Paterson, **57**, pp. 58–61.
[2] For fuller norms *see* **57**, pp. 130, 196.



89. TRIANGLE TEST [1] — GWYN

Material: A frame and four pieces.

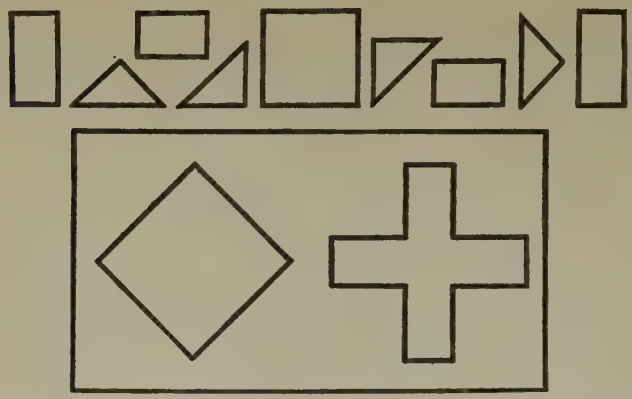
Directions: Place before S, board and pieces as illustrated above. Say, " Put this together as quickly as possible."

Scoring: Record time and errors. Time limit five minutes.

Norms: [2] 620 cases. (Pintner, Paterson)

	Age	5	6	7	8	9	10	11	12	13
Time	75 Percentile	*106*	61	42	29	35	33	30	30	*22*
	Median	*275*	108	77	64	58	55	49	48	*37*
	25 Percentile	*F*	*F*	240	123	120	89	90	86	*60*
Errors	75 Percentile	*18*	6	6	5	4	4	4	4	*2*
	Median	*27*	13	11	8	8	8	7	7	*5*
	25 Percentile	*F*	*F*	31	18	16	13	14	11	*9*

[1] Pintner, Paterson, **57**, pp. 40–41.
[2] For fuller norms, *ibid.*, pp. 116–118; 192–193.



90. TWO FIGURE BOARD TEST [1] — PINTNER

Material: Board and nine pieces.

Directions: Place before S, board and pieces as shown above. Say, " Put this together as quickly as you can."

Scoring: Record time and number of moves. Time limit five minutes.

Norms: [2] 911 cases. (Pintner, Paterson)

	Age	5	6	7	8	9	10	11	12	13
Time (Seconds)	75 Percentile	89	65	56	39	34	31	27	26	23
	Median	200	175	116	62	47	47	38	39	29
	25 Percentile	F	F	284	116	94	112	64	59	43
Moves	75 Percentile	15	13	13	11	10	10	10	10	10
	Median	21	24	20	14	12	13	11	13	11
	25 Percentile	F	F	40	21	18	22	15	15	13

[1] Pintner, Paterson, **57**, pp. 35–37.
[2] For fuller norms, *ibid.*, pp. 109–111; 190–191.

CHAPTER 7

Other Non-Language Tests

91. Cancellation
92. Identification of Forms
93. Maze
94. Slot Maze A
95. Tapping

91. CANCELLATION TEST — PYLE [1]

Material: A printed form of pied type beginning:
hplgvjembsfgtedbvmzkhfpoiabgjflurcqihdjoabkvt.

Directions: Tell S that he has before him a sheet with all the letters of the alphabet close together and all mixed up. He is to take his pencil and put a line through each one of the *a*'s. Tell S to work as quickly as possible, to be sure to cancel *all* the *a*'s and to be sure to cancel no other letter.

Scoring: Allow two minutes for Grades 2, 3, and 4, and one and one-half minutes for all grades above 4. Score is number of *a*'s canceled per minute.[2]

Norms: [3] 592 Boys — 628 Girls. (Pyle) [4]

Sex	Age	8	9	10	11	12	13	14	15	Adult
M	Average	7.8	9.2	10.4	11.4	13.8	13.2	16.9	*15.2*	22.2
	A. D.	2.3	2.3	2.8	3.0	3.8	2.8	4.1	*3.7*	4.4
F	Average	8.2	10.6	11.4	13.3	14.5	16.4	17.8	*18.9*	23.0
	A. D.	2.3	3.0	3.2	3.4	3.4	3.6	4.1	*4.8*	4.1

[1] **58**, p. 35.

[2] *See* Woolley, Fischer, **102**, pp. 108–122, for a different method of scoring and norms on 14 and 15-year-olds. Also for norms on 14 to 18-year-olds *see* Woolley, **100**, pp. 74–79.

[3] For adequate norms with capital pied type *see* Pintner, **56**, p. 106.

[4] For fuller norms *see* **58**, p. 36.

92. IDENTIFICATION OF FORMS TEST [1] — WOOLLEY

Material: Two sets of forms similar to above, made from quarter-inch board varnished and shellacked. One set is mounted on a black ebonized board $10\frac{1}{2} \times 2 \times 1\frac{3}{8}$ inches. A screen to put on table.

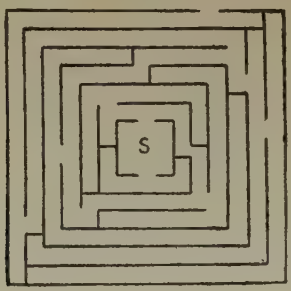
Directions: The screen is put before S's face so that form board is hidden from his view. Say, " You are to feel one of the shapes and after I take the screen away you are to point to the one you felt. Run your finger around the edge of this (giving the sample, *viz.*, the mate to the unnumbered piece) so you will know its shape." If the correct form is chosen, say, " Yes, they are alike," and place it on its mate. If S chooses incorrect form show him the sample. Point out its likeness to the mate and have him feel it again. Caution him to feel the others well because after this he is to be allowed only one attempt. Present forms in consecutive order, 1 to 8.[1]

Scoring: Time limit for feeling shape ten seconds. Allow $12\frac{1}{2}\%$ for each correct choice.

Norms: [2] 500 Jewish cases. (Dewey, Child, Ruml)

Sex	Age	9	10	11	12	13
M	Average percent . .	63.3	65.1	71.0	70.1	71.9
	S. D.	20.0	18.8	17.5	25.5	18.0
F	Average percent . .	57.9	57.7	64.9	61.5	67.0
	S. D.	18.5	18.5	19.3	15.8	19.2

[1] Dewey, Child, Ruml, **44**, pp. 30–31.
[2] For fuller norms, *ibid.*, p. 79.



93. MAZE TEST — PORTEUS [1]

Material: Graded series of thirteen mazes, black lines on white paper, as illustrated above.

Directions: [2] *Test for years three and four.* Tell S to draw between black lines as carefully as he can without touching them. Demonstrate. Allow two trials. *Test for year five.* Tell S that the double lines represent roads, some of which are open and some closed. Then point out openings at the end of two roads and lines blocking exits of other five roads. Illustrate motion of passing through open spaces and show S that he cannot go through the blocked spaces. Then say, " Start here and go out the first open road you come to." Allow two trials. *Test for year six.* Tell S where to start and point out exit to him. Caution him not to go into any blocked roads or to cross any lines. Allow two trials. *Test for year seven.* Procedure same as above, except that exit is not pointed out. Allow two trials. *Tests for years eight to fourteen.* Say, " Start here and find your way to the open place." Allow two trials for years eight to eleven, and four trials for years twelve and fourteen.

Never begin testing above the five-year level. Continue testing until two successive years are failed. Do not allow S to correct error by retracing course. If S fails on one test, but succeeds on the next, the latter should be turned upside down and the test repeated, giving the allotted number of trials. Final score in this case is the record on the retrial.

[1] **142.**

[2] For minor precautions in giving tests and detailed information as to scoring and norms *see* Porteus, **142.** The author stresses the importance of following the procedure exactly.

If S is ever retested, invert tests and allow one trial up to and including eleven years, and three trials above this level.

Scoring: If test is begun at five-year level, allow basal age of four years. Credits assigned as below.

III. 3 year credit — not more than 3 errors in crossing line on either trial.
2 year credit — any attempt to follow outline.

IV. 1 year credit — not more than 2 errors. If basal, credit 4 years.

V. 1 year credit — (*a*) 1st opening 1st trial.
(*b*) 2d opening 1st trial, 1st opening 2d trial.
½ year credit — (*a*) 2d opening both trials.
(*b*) blocked road 1st trial, but 1st opening 2d trial.
0 year credit (but not failure) blocked road 1st trial, 2d opening 2d trial.

VI, VII, VIII, IX, X, XI. 1 year credit each if passed on 1st trial.
½ year credit each if passed on 2d trial.

XII and XIV Passed

Sum of Trials	*Credits*
2	5 yrs.
3	4 yrs.
4	3 yrs.
5	2½ yrs.
6	2 yrs.
7	1½ yrs.
8	1 yr.

XII Passed — XIV Failed

Trials	*Credits*
1 to 3	1 yr.
4	½ yr.

Adult Tests

Trials	*Credits*
2	2 yrs.
3	1½ yrs.
4	1 yr.

XII Failed — XIV Passed

Trials	*Credits*
1	2 yrs.
2	1½ yrs.
3	1 yr.
4	½ yr.

Retesting: Deduct one year for each failure. Add together trials in XII and XIV year tests and credit as follows:

XII and XIV Passed

Sum of Trials	*Credits*
6	1 yr.
5	2 yrs.
4	3 yrs.
3	4 yrs.
2	5 yrs.

XII Passed; XIV Failed

Trials	*Credit*
1–2	1 yr.
3	½ yr.

XII Failed; XIV Passed

Trials	*Credit*
1–2	1 yr.
3	½ yr.

Norms: Norms have been reduced to age level performances as indicated above.

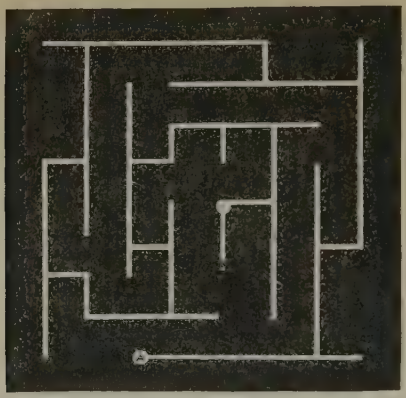


Illustration by courtesy of C. H. Stoelting Co.

94. SLOT MAZE TEST A — YOUNG [1]

Material: [2] Board with continuous slot, cut in metal, with numerous blind alleys extending from starting point to goal. A miniature clown boy acts as the goal, and a toy shoe mechanically held in slot is used as a stylus.

Directions: Say, "See this boy? This is his shoe. The boy wants his shoe. I want you to take it to him. See how quickly you can take the shoe to the boy."

Scoring: Time limit five minutes. Give second trial if first is successful. Say, "See if you can take it to him quicker this time."

Norms: [3] (1) 3141 cases. (2) 2673 cases. (Young, Daugherty)

[1] **152**, pp. 73–82.

[2] A more difficult test, Slot Maze C, has been devised by Young but up to date results have not been published.

[3] By courtesy of Herman H. Young and Dorothy C. Daugherty. Study as yet unpublished.

(1) Time in Seconds for First Trial

Sex	Age . . .	4	5	6	7	8	9	10	11
M	75 percentile	125	73	47	37	28	22	20	17
	Median . .	291	173	90	67	42	28	27	23
	25 percentile	F	F	186	133	77	43	43	33
F	75 percentile	268	150	91	58	40	27	25	20
	Median . .	F	F	147	124	74	40	31	28
	25 percentile	F	F	F	F	170	64	50	42

(2) Time in Seconds for Second Trial

Sex	Age . . .	4	5	6	7	8	9	10	11
M	75 percentile	*54*	30	23	21	17	15	15	13
	Median . .	*95*	50	34	25	21	18	17	15
	25 percentile	*230*	127	77	42	34	25	22	19
F	75 percentile	*56*	40	28	24	21	18	16	15
	Median . .	*173*	89	49	32	29	22	19	18
	25 percentile	*F*	199	129	63	66	29	25	23

95. TAPPING TEST [1] — WHIPPLE-HEALY

Material: Printed blank with one hundred and fifty half-inch squares, ten in a row.

Directions: Present blank with narrower sides top and bottom. Say, "This is a test to see how well you can use your hands. When I say, 'Go,' make a little tap with your pencil, like this," (show how the taps are made rapidly across one row and back on the next line) "one in each square, trying never to miss a square and never to touch any lines. See in how many squares you can tap before I say, 'Stop.' Hold the paper firmly with your other hand." Warn S that only light taps are necessary and that he should not stop to correct errors. After the first trial, turn the paper upside down, erasing dots if space is needed, and get a second record, saying, "Now let us see if you can do better this time."

Scoring: Observe the performance closely to detect errors, *i.e.*, touching a line, omission or duplication of a dot. Time limit thirty seconds. Record errors and number of squares tapped. For final score, (*i.e.*, index number) deduct from total number tapped two for each error and take better record.

Norms: [2] 1444 Males. 809 Females. (Mt. Holyoke)

Sex	Age	7–8	8–9	9–10	10–11	11–12	12–13	13–14	14–15	15–16	16–17	17 & over
M	Median	43	46	52	61	65	69	72	77	80	82	90
F	Median	45	53	58	69	75	74	80	84	88	87	89

[1] Hewes, **224**, pp. 113–119.

[2] For fuller norms, *ibid.*, p. 117.

Since the above was written we have established what we consider to be fairer norms, scoring time and errors separately.

Norms: 1205 Males. 812 Females. (Meehan, Shimberg)

Speed Scores by Sex and Age

Sex	Age . .	8	9	10	11	12	13	14	15	16	16+
M	75 Percentile	*54*	60	65	73	75	81	87	90	98	99
	50 percentile	*51*	53	58	63	67	74	80	81	87	91
	25 percentile	*45*	47	51	55	60	66	71	73	78	79
F	75 percentile			*71*	*78*	82	92	94	97	100	103
	50 percentile			*63*	*69*	73	84	85	87	91	95
	25 percentile			*54*	*63*	66	72	77	80	82	87

At every age the 75 percentile for errors is 0; the median is 0 to 1; and the 25 percentile is 1 to 2.

CHAPTER 8

Inadequately Standardized Tests

96. Block Design
97. Color Cubes (Kent-Kohs)
98. Color Naming
99. Composition — Controlled
100. Constant Increment
101. Continuous Subtraction
102. Cube Construction
103. Error Checking
104. Floor Plan
105. Form Board II
106. Free Association — Continuous
107. Furniture
108. Geometrical Objects
109. Hollow Square
110. Imaged Cube
111. Ink Blot
112. Instruction Box (Healy)
113. Inverted Figures
114. Land Section
115. Memory for Sentences
116. Mixed Relations
117. Multiple Choice
118. Object Completion
119. Peg Design
120. Spatial Relations
121. Substitution (Thurstone)
122. Verbal Directions
123. Visual Designs (Ellis)
124. Wheels
125. Worcester Form Boards
126. Word Building (Kent)

96. BLOCK-DESIGN TEST [1] — MAXFIELD-KOHS

Material: Sixteen colored cubes and seventeen graded patterns. (For example, see Test 59.)

Directions, Scoring, and Norms [2] supplied with material.[3]

97. COLOR CUBE TEST — KENT-KOHS

Material: Sixteen color cubes. Four designs lettered C to F; eight designs numbered 1 to 8. (For illustration of similar designs, *see* Test 59.)

Directions: Place Design C on table, slightly inclined. Show S nine blocks, and point out the fact that they are all alike. He is to arrange the blocks so that the colors will form C. S is aided if necessary, but receives credit only if he performs task without assistance. If he is aided, he is allowed second trial, after which Designs D, E and F are presented. If Design C is formed easily, numbered series is presented in serial order, being discontinued after one failure. If S has nearly completed design within time limit, he receives no credit, but is permitted to finish, and to try the next design. If S fails on one of the first three numbered designs, he is given letter series.

Blocks are mixed up between trials and S is allowed only necessary number of blocks each time.

Scoring: Record time. Time allowance for letter designs indefinite; for designs 1 to 8: — $1\frac{1}{2}$, 2, 2, 2, $2\frac{1}{2}$, 3, $3\frac{1}{2}$ and 4 minutes respectively. Translate time records into mental ratings from table below. Final score is median rating of tasks discriminative for S.

Norms: [4] (tentative) 150 cases. (Kent)

[1] Kohs, 195.

[2] Norms are based on 367 cases, no age group being larger than 37.

[3] An entire book, Kohs, 195, is devoted to a very detailed discussion of this test.

[4] From letter by Kent to the authors.

MEDIAN SCORES (SMOOTHED) IN SECONDS BY AGE FOR EACH DESIGN

Age	6	7	8	9	10	11	12	13	14	15	16
C	75	44	38	33	27						
D	96	62	54	46	38	30					
E	135	80	72	63	55	47					
F		135	78	68	58	50					
1	70	52	39	31	25	19	14				
	53	40	32	26	20	15	below				
2		85	65	47	34	21					
		66	48	35	22	below					
3		95	77	62	47	32					
		78	63	48	33	below					
4			115	95	77	62	47	37			
			96	78	63	48	38	below			
5			175	155	135	115	95	77			
			156	136	116	96	78	below			
6			215	195	175	157	142	127			
			196	176	158	143	128	below			
7						250	230	212	197	182	167
						231	213	198	183	168	below
8											240
											below

98. COLOR-NAMING TEST — WOODWORTH-WELLS [1]

Material: Test blank showing one hundred patches of color (red, yellow, green, blue, and black) with five sample patches.[2]

Directions: E lays blank before S with only sample line of five colors showing. After S has named these correctly, the whole blank is exposed, and S names the colors in order.

Scoring: Record time for each half of blank and number of errors.

Norms: No adequate norms established.

99. COMPOSITION-CONTROLLED TEST — WINCH [3]

Material: Ten words written at the top of a page, as follows: thief, landlord, crab, shake, hotel, basket, cries, provisions, escape, custody.[4]

Directions: S is told to write the longest story he can, using, in any order, each of the given words at least once. E emphasizes the fact that S is to think out the story before beginning, and not to include sentences having no direct bearing on the story.

Scoring: Test is scored according to number of meaningful units.

Norms: No norms established.

[1] **170**, pp. 49–52.

[2] A similar test may be found in the Form-Naming Test, Woodworth, Wells, **170**, pp. 50–52; the Color-Form Test, Dearborn, Shaw, Lincoln, **201**, pp. 20, 38–40.

[3] **149**, pp. 95–125.

[4] For alternative sets of words, *ibid.*, pp. 112, 120, 122, 123, 124.

100. CONSTANT INCREMENT TEST — WOODWORTH-WELLS [1]

Material: Page of one hundred selected two-digit numbers.[2]

64	72	47	30
49	35	43	56
62	51	35	44
57	30	64	31
68	56	49	37
74	44	67	60
53	36	28	71
67	73	46	48
25	63	55	53
40	47	65	61
61	43	70	36
71	66	41	42
33	69	62	34
38	37	25	39
28	39	40	33
65	32	57	73
41	59	26	38
50	31	68	63
42	60	66	58
58	48	27	32
52	54	51	59
70	46	69	52
26	55	29	45
34	27	74	72
45	29	50	54

Directions: S is presented with the form and required to make orally the same arithmetical operation, determined by E, on each number.[3]

Scoring: Record time and errors.

Norms: No adequate norms established.

[1] **170**, pp. 46–48.

[2] A similar test may be found in the Kraepelinian *Rechenhefte* reported in *ibid.*, pp. 42–46.

[3] Woodworth, Wells have used the addition of 4, the addition of 17. They advise the use of two tests of one column each.

101. CONTINUOUS SUBTRACTION TEST — KRAEPELIN

Material: None. Test entirely oral.

Directions: Illustrate test by subtracting 3's from 22. Then ask S to subtract continuously as rapidly as he can 4's from 51, or 7's from 100, 1's and 2's alternately from 50, etc.

Scoring: Record S's oral responses, total time and errors.

Norms:[1] No adequate norms established.

[1] Sherman, **145**, has concluded that an adult should be able to complete the subtraction of 7's from 100 within one minute with a maximum of two errors.

102. CUBE CONSTRUCTION TEST [1]

Material: [2] (*a*) Model I, a block three inches square and one inch deep, marked into one-inch cubes, and painted red on the four sides, but not on the top and bottom; nine one-inch cubes, four painted on two sides, four on one side, and one unpainted.

(*b*) Model II, similar to Model I, but painted on the top; nine one-inch cubes as above.

(*c*) Model III, an unpainted two-inch cube cut so that it looks like a composite of eight small cubes; eight one-inch cubes painted on three sides.

Directions: (*a*) Present Model I and cubes, saying, "Notice that this model is painted on the sides but not on the top or bottom. These blocks can be put together to make one just like it." Demonstrate, and then present blocks in irregular order. Tell S to construct cube.

(*b*) Present Model II and cubes saying, "These blocks can be put together to look like this model." Do not demonstrate solution.

(*c*) Present Model III and cubes. Repeat above directions and add, "Remember it is not painted on bottom, top, or sides."

Scoring: Record moves and time in seconds for assembling each model. Moves are all placements designed to complete or alter the structure. Time limit for each model is two minutes. Total score is sum of points for moves and for time. At end of time limit penalize each block left misplaced by adding three moves to the score, and for each unassembled block add six moves. Give no credit for time if blocks are not all assembled. Assign points according to scale below:

Models I and II		Model III	Model I		Models II and III
Points	*Moves*	*Moves*	*Points*	*Seconds*	*Seconds*
5	9	8	5	1–10	1–20
4	10–11	9–10	4	11–25	21–30
3	12–15	11–15	3	26–50	31–50
2	16–25	16–25	2	51–80	51–80
1	26–50	26–50	1	81–120	81–120

Norms: No adequate norms established.[3]

[1] Yoakum, Yerkes, **72**, pp. 105–107. [2] For a similar test *see* Test 64.

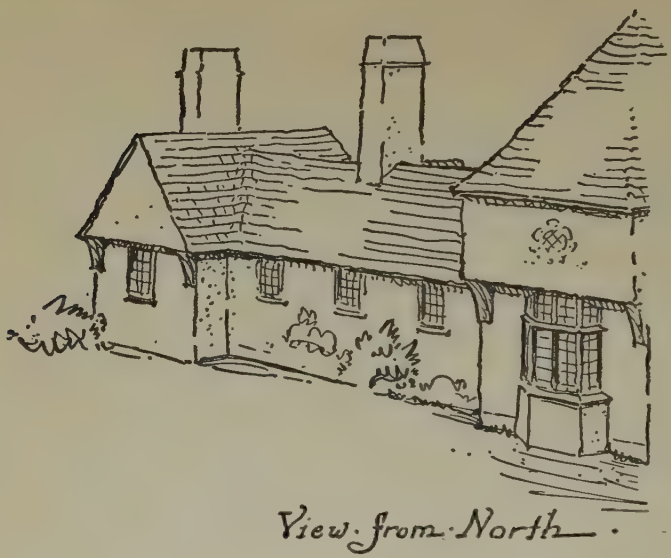
[3] Average score for 227 men, 200 of whom had obtained D or E lowest grade on Army Alpha, was 12 (**103**, p. 403).

103. ERROR CHECKING TEST — THURSTONE

Material: One hundred and seventy examples in subtraction and addition with answers.

Directions: S is told to check as quickly as possible each wrong answer.

Scoring and **Norms** not yet established.



104. FLOOR PLAN TEST — HEALY

Material: Representation of two views of the same house from opposite exposures. (Part of one of these is illustrated above.)

Directions: S is asked to draw a floor plan of the house. Detailed explanation is included on each blank.

Scoring: No time limit.[1] Compare subject's drawing, unit by unit, with key and deduct for omissions and errors as indicated.

Norms:[2] 94 High School Freshmen. 166 College Juniors and Seniors. (Shimberg and Meehan)

Percentiles	100	75	50	25	0
College Juniors and Seniors	172	144	108	69	0
High School Freshmen . .	151	91	46	16	0

[1] In working with students in high school and college, twenty minutes was found ample in the majority of cases.

[2] Judge Baker Foundation study as yet unpublished. Test standardized after manuscript went to press.

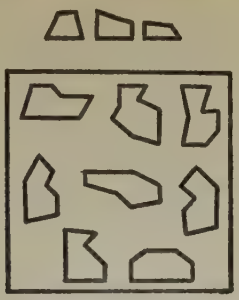


Illustration by courtesy of W. F. Dearborn.

105. FORM BOARD 2 TEST [1] — DEARBORN-ANDERSON

Material: [2] Board and three blocks.

Directions: Give the three blocks to S and tell him that, if properly placed, they will fill each hole. Point to each depression in turn, having S fit in blocks. If S does not complete the first problem in three minutes E solves it, commenting on how well the blocks fit. With depressions 2, 3, 4, etc., if no block has been successfully placed at the end of two minutes, count it a failure. If one or two blocks have been correctly placed, however, allow three minutes.

Scoring: Record time for each problem. Time limit as above. Final score is total time.

Norms: No adequate norms established.

[1] Dearborn, Anderson, Christiansen, **200**, pp. 450–452; Dearborn, Shaw, Lincoln, **201**, pp. 24–25; p. 46.

[2] A modification of this test has been devised to adapt it for younger children. *See* **201**, p. 24.

106. FREE ASSOCIATION TEST — CONTINUOUS METHOD [1]

Material: None.

Directions: Say to S, " When I say ' Now ', begin with any word you wish and keep on saying words as fast as you can until you have given one hundred different words. You may give any words you like, but they must not be in sentences. I will tell you when to stop." [2]

Scoring: Record words and total time.

Norms: No norms established with this particular method.[3]

[1] Cattell, Bryant, **159**, p. 231; pp. 233–236.

[2] Whipple, **67**, p. 45.

[3] For full description of alternate method, *ibid.*, pp. 44–53. For group testing by the written method, Pyle has established norms reported in **58**, pp. 24–27.

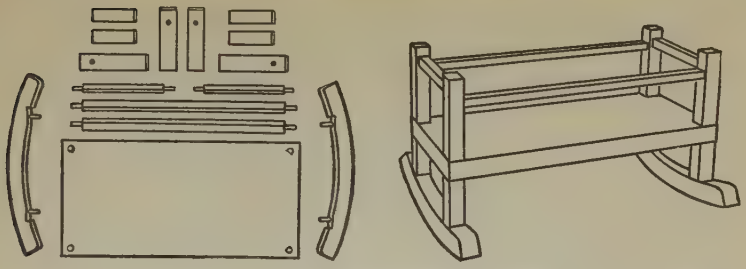


Illustration by courtesy of W. F. Dearborn.

107. FURNITURE TEST [1] — DEARBORN

Material: Fifteen pieces of wood.

Directions: S is shown material, as above, and is told to make a piece of furniture, using all the blocks and working as quickly as he can. He may move the pieces around as he wishes. If he does n't use all the blocks he is asked to try again, being sure to utilize this time all pieces. A third trial is allowed if necessary.

Scoring: Record time for each trial, and name S gives to object made. Score one for each piece used in building. Subtract one for each long or short rail not parallel with the large baseboard. Final score is best score of three trials.

Norms: No adequate norms established.

[1] Dearborn, Shaw, Lincoln, **201**, pp. 35–36. This is a modification of the Chair Construction Test described in Dearborn, Anderson, Christiansen, **200**, pp. 455–458.

108. GEOMETRICAL OBJECTS TEST — RUGG [1]

Material: [2] Written list of eight problems as follows:

1. Wedge.
2. Four triangles attached to a square, bases coinciding with sides of square.
3. Square box with lid attached. Assume lid is open, showing no thickness.
4. Three squares attached to equilateral triangle, one side of each square coinciding with a side of triangle.
5. Triangular pyramid resting on a triangular prism, bases coinciding.
6. Window with triangular top and square bottom. (Bounding lines only)
7. Wedge resting on a cube, edges coinciding.
8. Square window divided into four panes.

Directions: Tell S to form a mental picture of each object and count the number of straight lines which it would take to construct it in space.

Scoring: Time limit for whole test is ninety seconds.

[Key: (1), 8 or 9; (2) 12; (3) 15; (4) 12; (5) 12; (6) 5; (7) 17; (8) 6.]

Norms: No norms established.

[1] **61**, pp. 41–42.
[2] *Ibid.*, pp. 41–42.

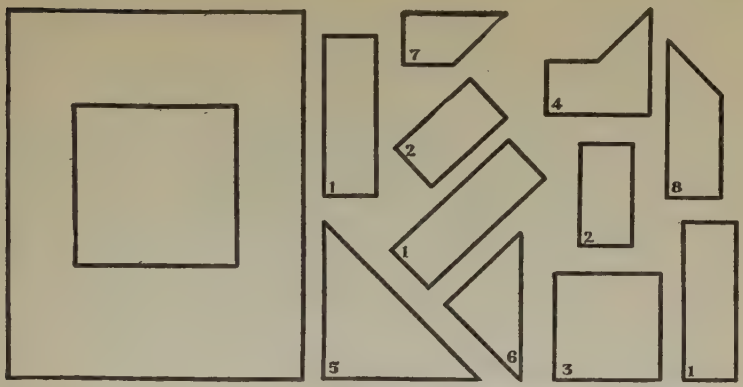


Illustration by courtesy of W. F. Dearborn.

109. HOLLOW SQUARE TEST [1] — LINCOLN

Material: Board and eleven pieces inconspicuously numbered as above.

Directions: E hands three No. 1 pieces to S and tells him to fill up the hole as quickly as he can. He is urged to keep on trying until one minute has elapsed, after which the solution is demonstrated if necessary. E then presents in the same manner seven other problems, including pieces as below: [2]

(*b*) 1 2 3
(*c*) 5 6 8
(*d*) 1 2 7 8
(*e*) 1 2 4 7
(*f*) 1 6 7 8
(*g*) 2 2 4 8
(*h*) 2 4 6 8

Scoring: Time limit for each problem one minute. Final score is total number of problems correctly solved.

Norms: No adequate norms established.

[1] Dearborn, Shaw, Lincoln, **201**, pp. 32–33.
[2] From letter to authors.

110. IMAGED CUBE TEST [1] — McCALLIE

Material: None.

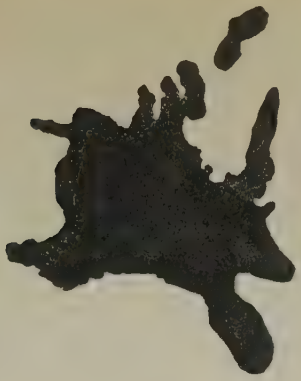
Directions: [2] Tell S that he is to imagine a three-inch cube painted red on all sides and cut into one-inch cubes. Say to S, "How many of the one-inch cubes will have paint on three sides, how many on two sides and how many on one side, and how many will have no paint at all?" Allow no pencil or paper.

Scoring: No time limit. (Key: eight cubes have paint on three sides, twelve on two sides, six on one side and one has no paint at all.)

Norms: No norms established.

[1] First suggested in 1916 at the American Psychological Association. *See* Doll, **190**, pp. 176–178.

[2] For an interesting supplement to this test see Test 64.



111. INK-BLOT TEST — WHIPPLE [1]

Material: Twenty standard ink-blots, such as illustration above.

Directions: [2] S is told that the blots before him do not represent anything in particular, but will probably suggest things to him. When the signal is given, he is to take the paper off the top of the pile and write down as quickly as possible the first thing which each blot suggests. S is cautioned not to waste too much time on any one blot. Be sure that S keeps card in upright position, *i.e.*, with number at the bottom.

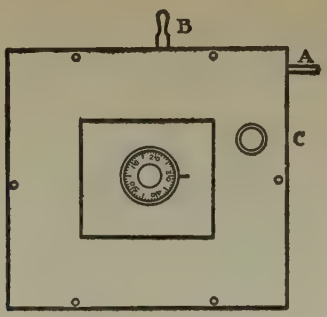
Scoring: Allow three minutes for the test. The score is the number of blots for which names of objects are written.[3]

Norms: No adequate norms established.

[1] 67, p. 254.

[2] This test has been given in many different ways. For full discussion and bibliography, see Whipple, 67, pp. 254–260.

[3] Pyle, 58, p. 34.



112. INSTRUCTION BOX TEST [1] — HEALY-HAYES

Material: Instruction box.[2]

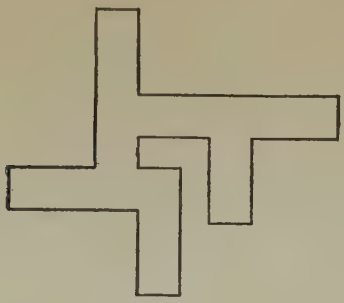
Directions: Tell S that the door of the box can easily be opened if he follows directions. Then E proceeds to carry out each step in plain view of S while explaining. The box being in the position illustrated above, E points to A and says, "First you pull this straight out as far as it will go, and hold it out." With the other hand, taking hold of B, say, "Then pull out this one and hold it out." Continuing the actual process, say, "Now, still holding these, turn the box up on the white side like this; then you push this knob (*c*) as far over as it will go in this direction (to the right). Then you turn the dial to the right so that the number 50 comes exactly to this mark. Then you turn it to the left until the number 49 comes exactly to the mark. Now turn to the right again until you hear a click. Then you can push the door open." (To close box follow steps in reverse order. This however, is not a part of the test.) Then ask S to open box.

Scoring: Record total time and details of performance step by step. Give three trials if necessary and repeat directions each time.

Norms: No norms established.

[1] Healy, Fernald, **49**, pp. 38–40.

[2] For another instruction box of a less mechanical nature see Dewey, Child, Ruml, **44**, pp. 31–35. The box they utilized (which was constructed by Hayes) is at present unobtainable but dimensions are given in the text. Test **42**, also a Hayes Instruction Box, is obviously not the same test.



113. INVERTED FIGURES TEST — ELLIS [1]

Material: A series of three cards with geometrical drawings.[2]

Directions: The first card is placed before S who is told to draw the figure as it would look if the card were turned until the bottom was where the top is now (*i.e.*, figure inverted). Card is left in plain view with position unaltered. Follow same procedure with other cards. S is given sufficient time to complete one figure before another is shown.

Scoring and **Norms** not yet established.

[1] This test was first used by F. W. Ellis of the N. Y. Neurological Institute.
[2] A similar test is incorporated in the Kuhlmann scale. *See* **249**, pp. 147–148.

114. LAND SECTION TEST — JOHNSON-GREGG [1]

Material: Sheet of paper on which are printed or typewritten in large letters the directions below.

Directions: "Draw a square. Consider it a map of a square mile with north at the top. Now draw within this square another representing the S. E. quarter of the S. W. quarter of the N. E. quarter."

Scoring and **Norms** not established.

115. MEMORY FOR SENTENCES TEST — WHIPPLE [2]

Material: Two sets of twenty-one sentences each, two to forty-two syllables long.

Directions: S is told to repeat after E each sentence exactly, word for word. Begin with a sentence well within S's grasp. Proceed until S has failed (*i.e.*, made a single substitution, insertion, or omission) on three successive sentences. (Material may, of course, be presented visually.)

Scoring: Final score is longest sentence S can repeat correctly.

Norms: No norms established.

[1] **52**, pp. 201–202.

[2] **67**, pp. 535–536.

116. MIXED RELATIONS TEST — WOODWORTH-WELLS [1]

Material: Two alternate test blanks each containing twenty pairs of word analogies,[2] *e.g.*, *Box : square : : orange : ——?*.

Directions: S is told to note "the relation of the second word to the first and then to write a word standing in the same relation to the third word." [3]

Scoring: Total number correct.

Norms: No adequate norms established.

[1] **170**, pp. 63–67.

[2] For other forms of Logical Relations Tests (*i.e.*, verb-object, action-agent, etc.) and standard lists, *ibid.*, pp. 56–67. Also in this book *see* Tests 2, 7, 14–19.

[3] Woodworth, Wells, **170**, p. 63.

117. MULTIPLE CHOICE TEST — YERKES [1]

Material: [2] Apparatus consisting of (1) bank of twelve hardwood keys operable by E from behind screen and by S in front of screen; (2) signal and switchboard (on E's side of screen) on which are mounted twelve miniature lamps, each connected with one of the keys. Also twelve jacks, each connecting with one of the keys, and also, if desired, with a bell; (3) box on which parts are mounted and in which mechanism is contained.

Directions: [3] S is seated before board and is told that in each trial one of the keys in each group will ring the bell (if that is the signal chosen). He is to try to find the correct key and to formulate as soon as possible a rule. Four problems, settings continued until S is successful. Before each new problem is presented, S is told that a change has been made.

PROBLEM I	PROBLEM II	PROBLEM III	PROBLEM IV
1st key at left	*1st key at left and 1st at right alternately*	*3d key from left*	*Middle key*
Settings	Settings	Settings	Settings
1–12	1–12	1– 8	1–5
5–10	5–8	10–12	4–12
10–11	3–10	2–10	2–10
6–12	1–12	9–12	10–12
2–10	4–9	3–8	1–9
7–11	2–11	8–11	3–5
3–11	5–8	4–10	1–3
9–12	3–10	7–9	2–12
8–10	2–11	5–12	6–12
4–12	4–9	6–9	8–12

Scoring: E keeps complete record of S's reactions, verbal comments and introspection. A problem is considered solved as soon as S states correctly the relation of the right key to the other keys. The number of trials preceding the correct solution (followed by no errors) or the total number of reactions may be considered the final score.

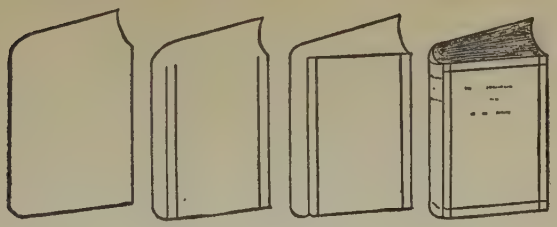
Norms: [4] No adequate norms established.

[1] **150**, pp 10–11; **151**, pp. 369–394. Also *see* Hamilton, **132**, pp. 33–66.

[2] Yerkes, **151**, p. 374 A simple multiple choice test with cards may be found in Yerkes, Foster, **259**. Also *see* vowel test, Burt, **289**, p. 203.

[3] **151**, pp. 379–382. Ten additional problems are suggested, *ibid.*, p. **392**.

[4] However, *see* results on 48 normal subjects, *ibid.*, pp. 385–393.



118. OBJECT COMPLETION TEST [1] — HEILBRONNER

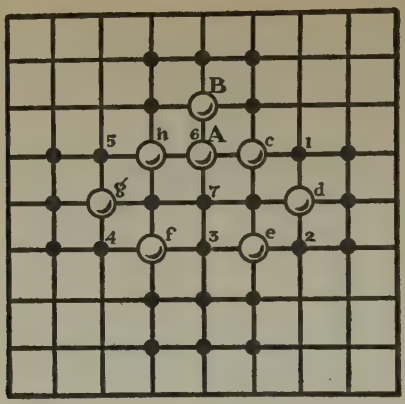
Material: Thirteen sets of cards, in each of which an object is progressively more completely represented. The sets are:

1. Bicycle (6 cards)
2. Fireplace (6 cards)
3. Book (4 cards)
4. Broom (4 cards)
5. Thermometer (6 cards)
6. Watch (6 cards)
7. Pencil (5 cards)
8. Phonograph (6 cards)
9. Lamp (4 cards)
10. Telephone (7 cards)
11. Pen (3 cards)
12. Butterfly (6 cards)
13. Windmill (7 cards)

Directions: Show S first card of a series and ask if he can tell what object it might represent. If he fails to identify it, the second card is shown to him, and so on, until he is able to name the object. Repeat for each of the remaining sets. E illustrates with one of the series.

Scoring and **Norms** not established.

[1] **135**, pp. 115–132; **Franz, 6**, pp. 86–91.



119. PEG DESIGN TEST[1]

Material: Pegboard with checkered surface, in which are thirty-three holes for pegs, in the form of a Greek cross (Japanese "Fox and Geese board").

Directions: *Part I:* Place before S board without pegs in place. Place pegs in order B, h, A, c, g, d, f, e. Tell S that if pegs are arranged correctly, they can be jumped off so that one will be left in center of board; that he will be asked to put the pegs in place now, and again later. While giving these directions, start with Peg A, and jump it into holes 1, 2, 3, 4, 5, 6, taking off Pegs c, d, e, f, g, h; then jump B into hole 7 and remove Peg A. Then tell S to try to reproduce design and jump the pegs. Give assistance, if asked for, through third trial. Allow as many trials as desired until S is certain he knows design. Put board out of sight. *Part II:* Thirty minutes later, ask S to reproduce design and jump pegs. Give no assistance.

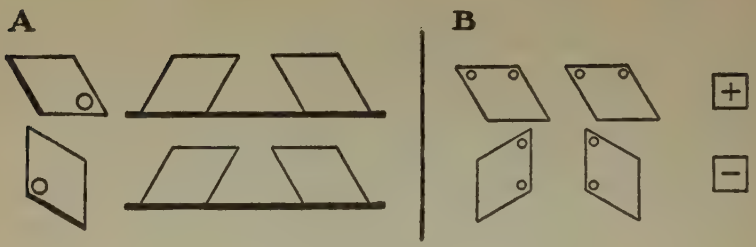
Scoring: *Part I* (*a*) Record time in seconds, from beginning of preliminary demonstration to end of last trial. (*b*) Record number of times design is reproduced. *Part II* (*a*) Record time for arranging pegs and jumping. (*b*) Record number of attempts to arrange pegs. Parts I and II are scored as successful if S finally arranges pegs unaided and jumps them off correctly.

[1] N. Y. Bureau of Analysis and Investigation, 40, pp. 54–60.

Norms:[1] 317 cases. (N. Y. Bureau)

	Part I		Part II		
Age	Average time (seconds)	Average times arranged	Average time (seconds)	Average times arranged	Success Per cent.
7	452	6	56	1	70
8	434	5	49	1	78.6
9	319	5	45	1	80.4
10	266	4	45	1	90
11	192	3	46	1	97.4
12	187	3	53	1	94.3
13	142	2	41	1	97.3
14	187	3	44	1	92.5

[1] Norms are inadequate according to our standards, but are here included so that E may have some gauge of S's performance on this rather unusual test. For fuller norms, *ibid.*, pp. 57–60.



120. SPATIAL RELATIONS TEST — THURSTONE

Material: Two forms as follows:
(*A*) 24 series of figures as illustrated above.
(*B*) 39 series of figures as illustrated above.

Directions:
For (*A*) S is instructed to superimpose mentally the first on the second or third figure, whichever is possible, and to draw a circle in the corner representing the position of the hole.
For (*B*) S is told that if the pair of diagrams represent the same face, he is to put a plus sign in the square.
Full directions are supplied on test blanks.

Scoring and Norms not yet established.[1]

[1] This test is in process of standardization by Walter B. Jones, University of Pittsburgh.

121. SUBSTITUTION TEST — THURSTONE

Material: Double sheet containing thirty columns of letters followed by a dash. Twenty words are placed at the top of the sheet.

Directions: S is told that each letter is the initial of one of the twenty words. He is to place beside the initial the last letter of the proper word.

Scoring and Norms not yet established.

122. VERBAL DIRECTIONS TEST B — WEIDENSALL [1]

Material: Ten white metal objects, about half-inch high, arranged in a row facing S's left, as above.

Directions: Twenty directions, to be read to S, are supplied with material, *e.g.*

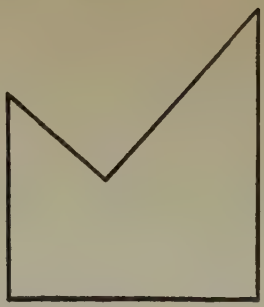
A. Put the shoe on the chair.

B. Tell me what object comes after the street car, and then tell me what one is just in front of it.

Scoring: Time each reaction separately and the test as a whole.

Norms: No norms established.

[1] 98, pp. 174–175. Another concrete directions test by the same author is reported in *ibid.*, p. 174.



123. VISUAL DESIGNS TEST — ELLIS

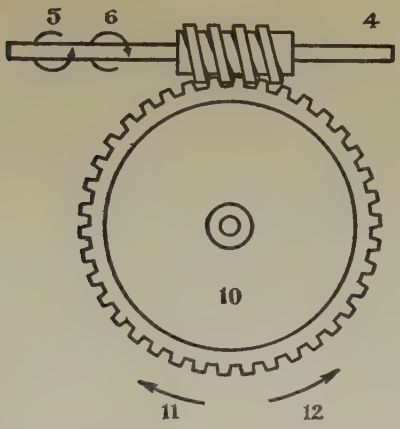
Material: A graded [1] series of ten geometrical designs,[2] each of which is drawn on a card.

Directions: Tell S that you are going to show him a figure on a card and that afterwards he is to draw from memory what he has seen. Expose each card (1–10) for five seconds, allowing sufficient time between exposures for S to draw the figure. Emphasize the fact that this is not a drawing test, but is only a test of his ability to remember what he sees.

Scoring and Norms not established.

[1] The order of difficulty established by F. W. Ellis, Neurological Institute, has been revised by Mabel E. Goudge, University North Carolina.

[2] It is to be noted that the Binet-Simon designs are included among these 10 figures. Also *see* Test 52.



124. WHEELS TEST — THURSTONE

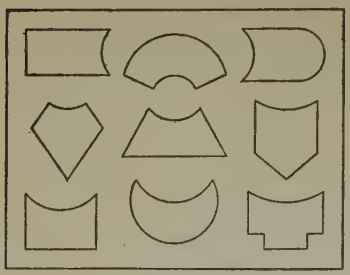
Material: Figure, part of which is illustrated above. Six problems as follows:

1. When the wheel 1 starts to move in the direction of the arrow 2, the wheel 7 will start to move in the direction of arrow No. ——.
2. When the shaft 4 starts to move in the direction of the arrow 5, the wheel 1 will start to move in the direction of arrow No. ——.
3. When the wheel 1 starts to move in the direction of the arrow 3, the wheel 10 will start to move in the direction of arrow No. ——.
4. When the wheel 7 starts to move in the direction of the arrow 8, the wheel 10 will start to move in the direction of arrow No. ——.
5. When the shaft 4 starts to move in the direction of the arrow 5, the wheel 10 will start to move in the direction of arrow No. ——.
6. When the wheel 7 starts to move in the direction of the arrow 9, the shaft 4 will start to move in the direction of arrow No. ——.

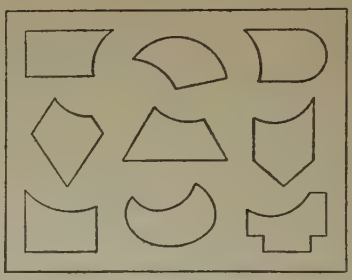
Directions: Show diagram to S and tell him to answer the questions.

Scoring: Record number of correct answers. (Key: 8, 3, 11, 12, 11, 5)

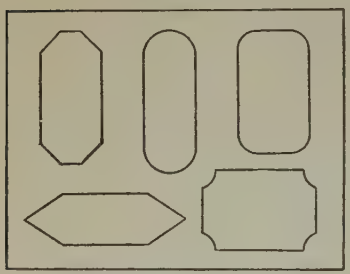
Norms: No norms established.



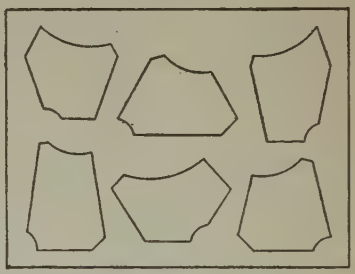
Board 1 a



Board 1 b



Boards 2 a, 3 a, 2 b, 3 b



Boards 2 c, 3 c

Illustration by courtesy of D. Shakow and G. Kent.

125. WORCESTER FORM BOARDS TEST — SHAKOW-KENT [1]

Material: Four form boards, each 26 × 20 cm. ($10\frac{1}{4} \times 8$ in.), made of thin light wood. The third and fourth boards are made to serve for four sets and two sets of blocks, respectively.

Directions: Place before S board as shown above, blocks being spread on table beside board. Say, "Put these blocks where they belong, as quickly as you can." For each board tell S how many blocks belong to each space. Series is given in order 1 *a*, 1 *b*, 2 *a*, 2 *b*, 3 *a*, 3 *b*, 2 *c*, 3 *c*. Discontinue after one failure except when S fails to solve 1 *b*, in which event permit him to try 2 *a*.

Arrangement of blocks is as follows:

1 *a*, haphazard.

1 *b*, all except two blocks (figures cut from rectangle and hexagon) turned over.

[1] 211, pp. 599–611.

2 *a*, 3 *a*, 3 *b*, haphazard (but no two blocks belonging together placed in close proximity).

2 *b*, one block of each pair turned over.

2 *c*, 3 *c*, as in 2 *a*, 3 *a*, and 3 *b*, above.

Scoring: [1] Record time in seconds for each board separately. Record as failure if not completed within the maximum time record included in norms for that board. Translate time records into age ratings. The final score is the median rating of the tests given, counting one failure as zero when the series is not completed. For a subject who completes the series, the score is the median of those ratings which are discriminative for him.

Norms: Adequate norms not yet established.

[1] Method to be employed after adequate norms have been established.

126. WORD BUILDING TEST — KENT [1]

Material: Eleven cards (about $1\frac{1}{4}$ inches square) with the following letters printed on them, one on each card:

C A T D O G B Y I R L

Directions: Cards are presented in random order. S is told to write as many words as he can make from the letters using no letter more than once in the same word. He is allowed to arrange the cards as he wishes.

Scoring: Time limit five minutes. Score is number of words correctly written.

Norms: No norms established.

[1] From letter to authors.

PART THREE

INTERPRETATION OF THE TESTS

CHAPTER 9[1]

Language and Ideational Tests

Introduction. Under this category are included all the tests which are chiefly linguistic or depend upon the ability to deal with ideational rather than concrete material. The classification is more or less artificial, because it is undoubtedly true that all tests, to a certain degree, call upon ideational processes. In this chapter are included all the tests of the so-called " higher mental processes ", *i.e.*, abstract reasoning, imagination, apperceptions, etc. Some pictorial tests also seem to fit in here, since they necessitate apperceptive rather than constructive or manipulative ability.

Cross-Line II (4). Cross-line II and also Cross-line I, an easier form of this test (see Test 4, footnote 1), are simplifications of the Code Test published by Healy[2] and later utilized in revisions of the Binet-Simon scale by Goddard and Terman.

Both Cross-line I and Cross-line II have an extremely narrow range of success and failure, and hence have little discriminative value for normal children. Morgenthau found, for example, that 60% of the children she tested, ranging in age from seven to sixteen years, made perfect scores.[3] Brigham found that 98% of the normal children he tested passed Cross-line I and 84% passed Cross-line II.[3] He believes, however, that these tests, together with the Code Test, are of great value in distinguishing normal from defective children. The " diagnostic value " of Cross-line II obtained by subtracting the percentage successful among defectives from the percentage successful among normals

[1] In Part III it will be noted that the lack of consecutive appearance of test numbers is due to grouping of the tests for interpretation. Consult index for place of discussion of any specific test.

[2] 49, p. 33.

[3] 54, p. 30.

was exceeded by only two tests in the Binet-Simon series.[1] We have long perceived that a very interesting feature of these tests is the differentiation which they show, in some cases very clearly, between visual memory and visual mental representation. The subject can often, from memory, draw and number correctly the figures in their entirety when he fails to recognize and number correctly the figures analyzed into their parts. This distinction between these two abilities may well be a matter for further investigation.

Essential Differences (5). The ability to educe differences is tested in the Stanford revision of the Binet-Simon scale, at the seven-year level. Terman states that this is generally considered an excellent measure of a subject's thought processes in which the concepts of similarity and difference necessarily play an important part. He suggests that it would be valuable to standardize such a test for the upper ages.

In the Essential Differences Test Kent has given us a scale discriminative from eight to fourteen or more years of age. The ability to recognize rather than to recall difference and similarity is tested.

Ingenuity (9). This is a rather unusual series of tests which are designed to measure an individual's ingenuity in attacking and solving a variety of problems. Some of them are hoary with age, as, for example, the match problems. Many others are of the puzzle type, examples of which frequently confront us in the newspapers. They are, none the less, interesting, and it is very true that the ability to solve such problems with dispatch is a valuable asset. It is extremely helpful to have these problems gathered together and standardized as a mental test.[2]

We may mention, in this connection, the Chassell tests for " originality ",[3] some of which are very similar to the above.

[1] **38**, p. 185.

[2] For an interesting collection of problems, *see* Dudeney, H. E., "Modern Puzzles and How to Solve Them." New York, Frederick A. Stokes Co., 1926.

[3] **128**, pp. 317–328.

Language Completion (10, 11, 12). The sentence completion method was first devised by Ebbinghaus [1] in 1905 under the name of "*Combinations Methode.*" Many passages with elisions have been devised, both in the form of paragraphs and sentences,[2] but the most widely used and best constructed tests of this kind at present are the Trabue Scales and their various modifications.

Trabue scaled a series of sentences [3] into eight short scales, several of which are equal in difficulty and thus interchangeable. We have found B and D most valuable for clinical use.

The short scales were intended primarily for the measurement of groups of children. For the adequate testing of the single individual, Kelley has rearranged the sentences [4] so as to form two equivalent exercises of forty sentences each. He has worked out a very ingenious method of scoring. He also provides norms for both age and grade. There seems to be considerable discrepancy between these; we should not expect the norms for eighteen-year-olds to be below the eleventh grade, etc.

We have found that for clinical use the original scales are usually too short, but on the other hand the time required for the Kelley tests is not always available. We have, therefore, from the original sentences compiled a new scale utilizing twenty sentences.[5] This has proved exceedingly practical and useful. We have standardized the test for both age and grade and have obtained very discriminatory age and grade norms which do not possess the discrepancy referred to above.

The Completion Test has been found very reliable. With the Ebbinghaus form, Simpson obtained a self-correlation of .92 [6]. Kelley found a correlation of .90 [4] between forms A and B.

The test has always been considered a good measure of intelligence. Fretwell regards the Trabue Completion Scale (he utilizes forms J and K) one of the most valuable tests for educational prognosis. He obtained a correlation of .76 with a composite of eleven tests including itself.[7] Correlating accuracy

[1] **106**, pp. 401–457.
[2] *See* Whipple, **67**, pp. 283–300.
[3] **120**.
[4] **109**, pp. 371–382.
[5] Judge Baker Foundation study as yet unpublished.
[6] **63**, p. 48.
[7] **46**, p. 27.

in Forms A and B with school standing, Kelley obtained a correlation of .859.[1]

In their study of dependent children, Stenquist, Thorndike, and Trabue used the Trabue sentences which they characterize as follows: "This test frankly measures intellect as applied to word meanings and relations. It is known to be symptomatic of success with school work in general."[2] Simpson found a correlation of .89 between the Ebbinghaus test and estimated intelligence.[3]

We have obtained (for adults) a correlation of .73 between Stanford-Binet Intelligence Quotient and our Modified Trabue Test. The fact that the Stanford-Binet series is itself so linguistic must be thought of in interpreting the high correlation between it and the language scales. But this very fact makes the language completion scale a good check on the Stanford-Binet findings; when there is a discrepancy between them one naturally analyzes the Stanford-Binet to see if the result is influenced by any special ability or disability.

Narrative Pictures (13). The game-like element which this test, with its brightly colored pictures, affords, makes a decided appeal to children. As the authors state, the Narrative Pictures Test may be improved by a more elaborate method of scoring, *i.e.*, partial credit for alternate pictures, and the use of another set of pictures as attractive to boys as these are to girls.[4] We also feel that the easy accessibility of the stamp-craft books to all children is a decided drawback to the utilization of this material.

A test similar to this, utilizing the Foxy Grandpa pictures, was included in the Army Mental Test Performance Scale.[5] Bowler standardized this test on "some 1012" cases ranging from 6 years to the adult level.[6] The test series of pictures is no longer obtainable, but can be found with others in book form.[7]

[1] **109**, pp. 371–382.
[2] **92**, pp. 9–10.
[3] **63**, p. 75.
[4] Dewey, Child, Ruml, **44**, pp. 29–30.
[5] Yoakum, Yerkes, **72**, pp. 115–116.
[6] **126**, pp. 37–54.
[7] Cupples and Leon, 470 Fourth Ave., N. Y., publishers.

Opposites (14, 15, 16, 17, 18); **Part-Whole** (19); **Genus-Species** (7); **Mixed Relations** (116); **Cause and Effect** (2). As Woodworth-Wells stated in their original monograph on association, the majority of logical relations tests (excluding picture tests) are distinctly linguistic.[1] Success in such tests depends in great part upon familiarity with the language for expressing the associations involved. The opposites tests have been most frequently employed because of the availability of material, the ease of scoring (there is a very narrow range of correct answers), and the general familiarity with this kind of association. Whipple in his manual (1915) gives nine of the " most common lists."[2] We have included in Part II five lists of varying length and difficulty. Results obtained by the various experimenters are not directly comparable, since the methods and material employed are so dissimilar.

Woodworth-Wells found that a subject's standing in the opposite (and also the supra-ordinate concept) tests correlated more highly with his average standing in all the tests, than any other of the logical relations tests. They conclude, therefore, that it is " representative of this general sort of controlled association." [3]

The consensus of opinion of investigators seems to be that opposites tests and intelligence ratings are closely correlated. King and McRory, testing 544 college students with seven tests, found that the opposites tests (hard) correlated " the most highly of any of the tests with university marks, for both boys and girls." [4] Simpson (with rather few subjects) found a correlation of .96 between a hard opposites test and estimated intelligence.[5] Bonser obtained a correlation of .85 between the opposites test and the total score for all the reasoning tests he employed.[6] He concludes that this is the best measuring rod for " reasoning ability." [6] Weidensall, in her study of criminal women, states that the Easy Opposites Test (Woodworth-Wells) proved to be the most reliable as an estimate of native capacity in all her battery of tests.[7] Means, after a very extensive research with a hard opposites test with 1628 subjects, concludes

[1] **170**, pp. 56, 65.
[2] **67**, pp. 71–89.
[3] **170**, pp. 56, 65.
[4] **86**, p. 38.
[5] **63**, p. 75.
[6] **124**, pp. 101, 105.
[7] **98**, p. 266.

that success in this test " is dependent upon native ability rather than years of schooling." [1]

In our experience, the easy and hard opposites tests measure very different capacities. As has been amply proved, the latter measure the subject's vocabulary, linguistic powers, and, to a considerable degree, his intelligence. When the material is so easy, however, that the responses are very familiar, as, for example, soft — hard; yes — no (from the Woodworth-Wells list), the test is really one of mental control. Whereas, success in this test is not significant, failure is often, as in the Continuous Subtraction Test, symptomatic of some psychotic or prepsychotic condition. In these tests (as well as in other logical relations tests) the difference between written and spoken responses must be taken into consideration. Speed and ease of writing often affect the results.

Next to the opposites tests, the Part Whole, Genus Species, and Mixed Relations tests are probably the most important. As far as we know, the only standardization of the first two tests are by Pyle. Apparently very few studies have been made with them. Wyatt used a Part Whole test of ten words and obtained a self-correlation of .65 and a correlation with estimated intelligence of .67.[2] The Mixed Relations Test is used by Burt (who terms it an analogies test). With his own test of one hundred problems, he found a reliability coefficient of .92 and a correlation with intelligence (by teachers' estimate) of .52.[3]

Woolley, in her scale, utilizes at the sixteen-year level the Cause and Effect Test. Here memory, as well as the ability to perceive logical relations, plays a certain part. Woolley states, however, that " the test is primarily one of understanding the relationship of cause and effect, and using the category in forming associations." [4]

For a more detailed discussion on Controlled Association, the reader is referred to the section on that topic in Whipple's Manual.[5]

[1] 164, p. 63.
[2] 71, p. 120.
[3] 42, p. 100.
[4] 100, p. 131.
[5] 67, pp. 71–89.

Pictorial Completion (20, 21). These tests were devised to supply for concrete material a test analogous to the completion test initiated by Ebbinghaus.

Pintner and Anderson have established an objective method of scoring for Pictorial Completion I and standardized it. They maintain that age scores differentiate performance up to but not including the adult level. Other investigators have also found it to be true that adult performances were inferior to those of children. Healy [1] quotes results on ninety-five college students, which are decidedly inferior to norms for children. This is perhaps to be explained on the basis that the scenes and figures represented on the board are cartoon-like and intelligent subjects proceed to complete the picture in a more or less bizarre fashion.

Moreover, as Gault points out, the correctness of a choice for any particular picture depends entirely on the point of view and the child's previous experience. For example, nothing essentially illogical has been attempted when a subject with a sense of humor makes the boy run away from a crying baby rather than a dog.[2]

We have concluded from our experience that the Pintner-Anderson norms run too low and that the test is very uncertain on account of the above factors. In our practice we have almost entirely discontinued the test in favor of the pictorial test more recently worked up by us.

Pictorial Completion II has none of the crude features of the earlier completion test. A very well-drawn and attractively colored series of pictures is represented, each of which depends essentially on the one that has gone before. Only one absolutely logical choice is possible for each of the eleven pictures. Graded scores for answers partially correct have been statistically determined. It is decidedly superior to picture completion tests of the Shaw type,[3] since the puzzle nature of fitting in the pieces has been eliminated. That is to say, there is the same neutral background for all the pieces and the subject cannot place a piece by merely matching contours of the same object, etc.

What is mainly required in Pictorial Completion II, is the

[1] **133**, p. 97. [2] **130**, p. 313.
[3] **144**, pp. 355–365; **201**, pp. 33–35.

ability to see the relationship between the objects and activities depicted and the missing piece, and to interpret the meaning of one element in the light of the others.

This test, therefore, gives one an opportunity to learn a great deal about such abilities while at the same time it never fails to evoke interest and to establish good rapport. Moreover, the familiarity of the scenes portrayed makes it very rare to find an individual who cannot understand the scenes depicted.

Some maintain that Pictorial Completion II measures concrete apperception, whereas the Language Completion Test measures verbal apperception. We agree with Morgenthau that it is impossible to state at this time just what we are testing. An interesting study correlating Pictorial Completion II with the Modified Trabue Test, holding constant the vocabulary as determined by the Stanford-Binet Scale,[1] yielded slightly positive but entirely insignificant results. We cannot state, of course, whether this is due to the fact that this vocabulary is not closely related to the kind of language ability required in the Trabue test or whether Pictorial Completion II tests an entirely different ability.

Moreover, Pictorial Completion II has been always found to correlate rather poorly with the Stanford-Binet Intelligence Quotient. The correlation of .44 on 282 fourteen-year-olds [1] is similar to the results found by other investigators. Perry, working with 346 feeble-minded, found it a very useful adjunct to the Intelligence Quotient and believes it indicates traits necessary for social adjustment.[2]

And indeed, although we have not yet been able to separate this test into its component elements, we feel justified in an *a priori* agreement with the original statement made by Healy. "Through its presentation of problems that are visual, nonlanguage, ideational, pictorial, a representation of everyday scenes and activities, this test brings into play an important mental ability — whether specialized as being related to observational and pictorial material or capable of wider interpretation — an ability that we would eagerly know more about for many practical purposes." [3]

[1] From an unpublished study by Regina Stolz, Wellesley graduate student.
[2] **139**, p. 85.
[3] **134**, p. 239.

Proverbs (22); **Syllogisms** (30). These tests are similar in that they test ability to deal with abstract material. The Syllogisms Test, of course, measures deductive reasoning. It involves purely logical processes, using very narrow and straightforward concepts within prescribed limits. We have reduced the element of chance in the final score by subtracting the correct from the incorrect answers. The Proverbs Test measures the ability to derive a somewhat hidden meaning from a figurative statement and to identify that meaning still differently expressed. We were not surprised to find a rather low correlation (.54 by method of rank differences) between these two tests.[1]

The difference between the sexes, however, is rather striking. In the Syllogisms Test there is a reliable difference between girls and boys at every grade from seven to twelve in favor of the boys. This may be due to innate superiority, or be a result of the different standards to which boys and girls are held in regard to clear-cut thinking.

The difference between the sexes in the Proverbs Test is much less consistent, although it is rather marked in the eleventh and twelfth grades, again in favor of the boys.

Revised Directions (24). In experimenting with the Woodworth-Wells Easy and Hard Directions tests, Pintner and Toops found that the former was discriminative only up to eight years and the latter only through thirteen years. Utilizing some of the questions in each of these tests and adding a few more difficult ones, they formulated a directions test that differentiates performance from six years of age to the adult level. The nature of the test has been somewhat altered in that speed, so important a factor in the original tests, is little emphasized. Pintner and Toops' norms, however, are merely tentative, and it is regrettable that this splendid test has not been more adequately standardized.

The original tests, at least, are chiefly a measure of the comprehension of silent reading. For this purpose, indeed, Gates concluded that they were equally as efficient as any of the "newer instruments" specifically devised for that purpose.[2]

[1] Judge Baker Foundation study as yet unpublished.

[2] **107**, p. 453.

Whitchurch [1] and Weidensall [2] found a fairly high correlation (.71–.76) between these tests and rating on "general intelligence" tests. Whitchurch emphasized speed and Weidensall accuracy.[3]

In her work with superior children, Jones obtained uniformly high results on this test. She believes that the ability to apprehend and follow directions is an important factor in the unusual educability of children of this group, and in fact in the training of all individuals.[4] The test thus holds an important place in psychological clinics because of its diagnostic significance, for educational and vocational adjustments. The ability to follow directions is certainly of great practical importance, but pencil and paper responses are much less frequently called for in life than the obeying of directions with actual rather than representative material. The former constitutes the distinctive feature of the Verbal Directions Test. It is interesting to compare all the different directions tests (including the various instruction boxes), noting that the directions may be given either verbally or in writing, and that the responses may be written or followed out in concrete form. We have here another opportunity for interesting research.

Scaled Information (25); Range of Information (23). As far as we know, the former is the only adequately scaled and standardized information test purporting to measure commonsense information with little relation to formal schooling. The final form of the test was decided on after eighty questions had been tried out on one thousand children. We believe that the tests have more than a merely local significance. Studies in states so widely separated as Oregon and Illinois, as well as in several cities in Massachusetts produced test results similar to each other.[5]

Age to age and grade to grade differences are regular, consistent and extremely reliable. The test is found to have a self-

[1] 99, p. 326. [2] 98, pp. 183–193.

[3] The low correlation Whitchurch obtained between accuracy and general intelligence was perhaps due to the fact that the tests were far too easy for any of her subjects. [4] 85, p. 58.

[5] Judge Baker Foundation study as yet unpublished.

correlation of .83 (360 cases from all grades). A fair correlation (.57) was found between poor scores on this test and school retardation.[1]

Whipple's Range of Information Test is really an extension of his vocabulary test, the words being so selected " that each shall be representative of some specific field of knowledge or activity." [2] From a performance one can ascertain the fields with which the subject is acquainted, *i.e.*, American history, golf, photography, etc. It should never be utilized as a gauge of his common-sense information.

Sentence Vocabulary (26). This consists of the first thirty words in each of the two original Terman lists, and ten out of the total remaining forty. The test measures the ability to recognize the meaning in a context rather than to define the meaning of the words. This is, of course, much more akin to everyday experience, and especially to the knowledge necessary to understand what one reads.

Terman emphasizes the importance of vocabulary tests. Investigating the reliability of the Vocabulary Test in the Stanford Revision, he found that its correlation with the entire scale was .91 for school children [3] (631 subjects) and .81 for adults [3] (482 subjects). He concludes that " mental age based on vocabulary score alone would not be far wrong in a large percent of cases." [3] We must remember, however, that Terman tested a rather highly selected group of children. His results may be due to local conditions. We are not at all prepared to state that the above generalization would apply to the usual clinical subjects, particularly in the case of children from ignorant families or with foreign-speaking parents; indeed we have much evidence to prove the contrary.

Silent Reading (27, 28, 29). We seem rather to encroach on the field of educational tests when we consider the many silent reading tests that have been evolved. The power of comprehension, however, basically important in both educational and

[1] Judge Baker Foundation study as yet unpublished.
[2] Whipple, **67**, p. 683.
[3] **119**, pp. 453–456.

general diagnostic testing alike, is what chiefly concerns us here. Paper tests purporting to measure other capacities are unreliable if the individual's ability to comprehend what he reads remains undetermined.

Silent reading tests have offered passages to be read and then partly reproduced in answer to set questions. Both speed and comprehension have usually been taken into account in the final score. The following running commentary on some of the tests used (given by authors' names) is based chiefly on the work of Gates,[1] who has made a very extensive statistical inquiry into their nature and merits.

Brown.[2] Gates [1] found that this test correlated zero with the other tests he employed. It consists of a selection from which the children read for one minute. Then they are asked to write as much as they can remember. Papers are scored for " quality " and " quantity." Since a great deal is left to the examiner's subjective judgment the test is difficult to score. This criticism is applicable in even greater degree to the Starch [3] and Gray [4] tests.

Burgess.[5] This test is unique in that each passage is illustrated by a picture which the child modifies, according to instructions given in the text. Gates points out that the units are rather coarse (*i.e.*, only a small number of paragraphs is the average) and that too much time is devoted to drawing. He concludes, however, that if certain minor changes were introduced, " it would . . . be vastly superior to any existing test of reading rate." It correlated more highly with the composite score than any other test (.82 for rate and .80 for comprehension).[1] Its reliability, according to the method of self-correlation, is also high (average for all grades .83).[6] The present " picture supplement " scale is, however, adapted only for lower grades and is not of much value above grade seven. Burgess stated in the original monograph that another scale for higher levels was in process of preparation. The more difficult scale, however, proved unsuccessful. She found that the longer words used merely made the material stilted and unnatural and had little effect on increasing difficulty. Burgess be-

[1] 107, pp. 303–314; 378–391; 445–464. [2] 104 [3] 118, pp. 1–24.
[4] 108. [5] 105. [6] 105, p. 129.

lieves that reading is hard in proportion to the complexity of the subject matter, and that the prognostication of ability to understand in such a case is better measured by intelligence scales than by any reading tests that we now have.[1]

Monroe.[2] This is one of the most widely used of the silent reading tests and has been described in Part II. The method of giving is rather clumsy. Often the child has to be given two or three forms before his reading comprehension and rate can be determined. Gates found that rate and comprehension correlated .92.[3] The Monroe, Brown and Courtis tests afforded the most reliable measure of rate of reading.[3]

Thorndike-McCall.[4] This test requires half an hour for giving, but is perfectly scaled and very reliable. Gates concludes that it " measures power of comprehension freed of the mechanical factors (speed) of reading." [5]

Word-Building (31, 126). This test (suggested by the game of anagrams) is said by Whipple to call for " ingenuity and active attention . . . ability to combine isolated fragments into a whole " and to be a measure, to a certain degree, of " the richness and readiness of the examinee's word vocabulary." [6]

The two best known forms are the A E O B M T and the E A I R L P combinations. The latter has been well standardized by both Pintner and Pyle. The difference in their results may be attributed, as Pintner suggests, to a slight difference in scoring, and to the fact that their subject groups were not entirely comparable.[7] With the A E O B M T Test, Wyatt obtained a reliability coefficient of .88.[8]

Kent believes that the kind of material she uses adds to the

[1] From letter to authors.

[2] **112**, pp. 303–312. This is based on the Kansas Silent Reading Test; *cf.* Kelley, **110**, pp. 63–80.

[3] **107**, pp. 303–314; 378–391; 445–464.

[4] McCall, **111**, pp. 31–51.

[5] **107**, p. 463. For an extended discussion of silent reading tests, *see* any of the standard books on educational measurement, *e.g.*, **276**. Also for bibliography *see* **314**, pp. 174–177.

[6] **67**, p. 274.

[7] Pintner, **56**, pp. 20–22. (Pyle, **58**, pp. 22–24.)

[8] **71**, p. 115.

value of the word-building test in making clear the requirements and in holding the subject to the rules.[1]

McGeoch, in his consideration of " imagination tests ", found a very low correlation between the two six-letter tests enumerated above and the ink blots and linguistic imagination tests. He concludes that the tests measure " almost entirely different types of functioning, and that a person may be judged highly imaginative by one test and very differently by another." [2]

We consider these tests useful for indicating mental resource and for the opportunity they afford to study methods of dealing with a task, *i.e.*, whether the subject systematically makes words, eliminating one letter after another in an orderly fashion, or whether he picks out letters haphazardly and combines them in a hit-or-miss manner. We have often found the test results much affected by the frequency with which the subjects have played anagrams or other word-building games.

[1] From letter to authors.
[2] 137, p. 442.

CHAPTER 10

Memory and Learning Tests

Introduction. For purposes of convenience, it has seemed best to gather into one chapter all the tests which are predominantly memory or learning tests. The overlapping with the chapter on Language and Ideational Tests is, of course, great, and the distinction largely arbitrary. Association and memory, to take one example, are certainly not separate processes. No test falling under one category could fail to fall, to a certain extent, under the other.

A survey of the field of memory tests, limited though they are, abundantly illustrates how arbitrary and poorly defined are the distinctions between any two mental functions. In the old days of faculty psychology one could speak of memory or association or learning powers. To-day, we know that good memory and learning powers for ideational material may be, and often are, coupled with an outstanding disability where rote material is concerned; that even in the latter field it is perfectly possible to be very adept at remembering digits and singularly deficient in associating geometrical symbols with numbers. Moreover, as regards recall of digits, a person may be able to repeat them very quickly when presented auditorily and only very slowly and inaccurately when presented visually. The implications for education and pedagogy are manifold. The twenty-four tests enumerated here represent only the first steps in an apparently unlimited field. Up to the present time, the major portion of experiments in learning have dealt with the learning process in connection with non-school material, *e.g.*, Book's studies of learning to typewrite, or Swift's experiments with throwing balls.

Aussage (33). The purpose of this test is to discover the ability of the subject to report faithfully what he has seen.

The results are rather unexpected. The norms for items correctly enumerated are almost precisely similar from eight years to the adult level, not only in regard to the averages but also the range. The same is true for errors, fictional items, and accepted suggestions. Thus the performance clearly depends on personality traits or special abilities, and the findings have deep legal implications.

The norms, reported in Part II, are inadequate. It seems impossible to combine the ratings so as to gain a true picture of the subject's performance. But important clues may be obtained concerning the subject's powers of observation, his imagination, his suggestibility, his veracity, and sometimes his powers of dramatization.

The work done with this test throws much light on the vexed question of the validity of testimony. Apparently, age has little to do with the veracity of the report. A child of ten is potentially as likely to be correct as an adult. Moreover, experience and training contribute little. A group of professional men, lawyers and the like, were tested, as well as the 377 random subjects mentioned in Part II. The average items correct for the first group was slightly *lower* than for the latter. There were more errors, more "don't knows", and the same number of fictional items. Again, sex differences were found to be negligible.

Our material, gathered in considerable quantity, is to be used for a later publication.

Card Sorting (34); **Marble Sorting** (48). The Card Sorting Test is more readily classified among psycho-physical than mental tests, though it has been widely used for both purposes. Woolley and Fischer and Weidensall consider it a good "measure of an eye-hand coördination." [1] Pyle includes a more complicated form of this test among his tests of learning ability and finds a steady increase in efficiency from eight to eighteen years, with an outstanding superiority for girls at every age. He insists that efficiency in distributing the cards does not depend only on reaction time. He finds a low correlation between early scores in his test and speed at distributing any cards.[2]

[1] 102, p. 101; 98, p. 82.

[2] 59, pp. 32–33.

This is also confirmed by Burt, who reports a negative correlation (— .11) between sorting and previous practice in handling playing cards.[1] Burt obtained a correlation of .52 to .56 between card-sorting and intelligence (as determined by teachers' estimates).[1]

Card sorting tests vary in the kind and number of cards employed and in the box and compartments into which they are to be sorted. The original Jastrow Test used forty-eight cards and four compartments. The Pyle Test uses seventy-five cards and a fifteen-compartment box.

Pyle has devised two other rather unusual sorting tests. The Marble Sorting Test can be given to children who cannot read and do not know their numbers. The colors, the animal pictures, and balls make this a very attractive test for younger children. In this test both boys and girls double their efficiency from six to thirteen years, girls consistently in the lead.

In the Manthanometer Test (48, note 2), the subject sorts colored balls of two sizes simultaneously. He has to remember complex directions and carry on several processes at the same time. Pyle states that this test measures " not only general learning capacity, but a specific type of ability, the type required in operating complex machinery such as an automobile." [2]

Cube Imitation (35). This test was first used by Knox in his scale for testing immigrants at Ellis Island. Pintner somewhat revised the method of administering the test and standardized it on normal and defective children. Very few perfect scores were obtained. The performance of normal children was found to be slightly better than that of the feeble-minded of corresponding mental age.[3] Pintner considers that success depends largely on ability to imitate, although other factors involving intelligence have ample opportunity to assert themselves.[3] Rachofsky also concurs in this opinion, stating that one of the advantages of the test is the chance it offers for resourcefulness and ingenuity. He finds that speed of presentation has a marked effect on ease of recall and that one tap every one and

[1] **41**, p. 137. [2] **59**, p. 56.
[3] **184**, pp. 377, 399.

one half seconds is most favorable. His subjects reported the test to be predominantly kinæsthetic.[1]

In our experience the variability of performance on repeated trials has led us to believe that the test is unreliable. Having formerly used it very extensively, we now employ it very seldom.

Digit Memory Span (36, 37). This test has been in wide use since 1887. As has already been pointed out, it may be given in a variety of ways.

The auditory method, however, has almost preëmpted the field and has played a large part in the determination of the Intelligence Quotient. Revisions may come and revisions may go, but one always finds the digit memory span test in a prominent place.

All investigators seem to agree that it tests an ability which increases with age. Starr has made an extensive investigation on two thousand subjects. Strangely enough, we ourselves, with nearly identical methods, were simultaneously collecting data on fifteen hundred normal cases. The results of the two studies are almost entirely similar and both contradict the age placement set by Terman in his revision of the Binet-Simon scale. This is probably due to the fact that the Stanford revision tests permit the repetition of a digit, the juxtaposition of consecutive numbers, etc.

Starr makes much of the fact that she finds a consistent though often very slight difference between normal and defective children, especially with the reverse memory span. From her study she makes rather startling deductions, as, for example, that, "In general, mental development varies directly as the ratio of the Reverse Span to the Forward Span." [2]

We find no ground for such a sweeping generalization. Indeed, it has been our experience that the Intelligence Quotient may be raised perhaps from the classification of moron to normal entirely on the basis of a very high memory span. On the other hand, an Intelligence Quotient is often considerably lowered because of a poor memory span. It is interesting to note that among the two hundred college freshmen Bingham tested, the

[1] 186, p. 63. [2] 188, p. 83.

memory span ranged from five, or below, to twelve, six per cent of the students failing to reproduce six digits.[1]

This is a test which is peculiarly liable to different performances, even with the same individual at different times. We always try to reduce this element as much as possible by motivating the test in some interesting fashion and by giving enough trials to ensure the individual's best performance. Moreover, there is often as much variation between the low and high percentiles of normal children as between medians of normal and defective children of the same age. It is very interesting in this connection to note that the correlation between an Intelligence Quotient and memory span will be spurious because of the overlapping of the identical elements. (We wonder if the Intelligence Quotient played any part in Starr's mental classification.) As far as our experience goes the specific application of a high memory span to everyday life is uncertain, except perhaps in the case of telephone operators. The reverse memory span is a useful single test of what we may term " mental control." Taking all things into consideration, however, we cannot help feeling that the value of the whole test has been greatly overestimated, as when in the superior adult tests of the Stanford revision, it may add a credit of twelve months of mental age.

Digit Symbol (38); **Substitution** (121); **Learning Z** (46); **Learning B** (43); **Learning C** (44). Substitution tests in various forms are widely used to test the rapidity with which a subject can form arbitrary associations with rote material. Tests Nos. 38 and 121 fall into this category. The subject does not have to commit the associations to memory, since the key is always before him, but the more quickly he can learn to dispense with the key, the more quickly he can complete his task. Woolley includes such a test in her scale of mental measurements. She believes it to be useful in testing the " routine type of efficiency which is demanded in many kinds of work." [2]

Healy and Bronner utilized the substitution principle in the visual and auditory memory tests known as Learning A and Learning B. Learning A was given in exactly the same man-

[1] **78**, pp. 131–134. [2] **100**, p. 87.

ner as Learning Z, but consisted of twelve rather than eighteen symbols. In this test, of course, the subject has to remember the associations, since the key is taken away after a certain learning period has been allowed. The high number of perfect performances on Learning A at all ages led to a modification of the test, resulting in Learning Z.

The learning processes required in these tests are apparently identical with some of the processes necessary in learning to read; *i.e.*, the association of a written symbol with a letter or a sound; the ability to reproduce the appropriate name or sound on seeing the symbol, etc. We must admit, however, that we have been unable to find any correlation between school retardation and Learning A or Z.[1] This may be, of course, merely due to the fact that in grade school, in the majority of cases, children are regularly promoted from year to year, despite certain disabilities. For the most part, the retarded school children seen in clinics have their school situation complicated by many factors — enforced absences, discouragement, unfortunate attitudes, etc. It would be more valuable and interesting to experiment with children entering first grade to determine if Learning tests Z and B correlate to any extent with speed in learning to read.

The difference between the results on the ordinary digit symbol test and Learning Z is indeed interesting. In regard to the former, Pyle comments that the "growth curve is . . . practically a straight line for girls up to age sixteen and for boys up to age seventeen."[2] In the latter (tried out on a large number of children representing, on the whole, a fair sampling of the population) the norms are in places irregular. From grades three to seven, however, they are practically uniform. There is a wide jump after grade seven, but from grades eight to eleven the norms are again more or less uniform. The drop at the twelfth grade may be due to the fact that we had a rather poorer group of subjects at this level. The definite cleavage between the lower and upper levels at grades seven to eight we are at a loss to explain. Any selection due to the working children having left school would be naturally expected in the seventh or ninth grades.

[1] Unpublished study by M. L. Penney.

[2] 59, p. 47.

Learning B is too short to be at all reliable, but as in Learning Z we again note the absence of age-to-age norms. We feel that this is significant and that success in this particular type of rote learning is a special ability often in distinct contrast to the subject's powers with ideational material. Whereas, however, age-to-age distinctions cannot validly be made, still there is a wide range of individual scores at every age. For Learning Z we have prepared percentile tables, so that the relative quality of the subject's performance may be determined. We believe that tests such as these are of decided use in the clinic.

Learning C was devised to ascertain what effect motivation would have upon ease of learning. The problem involved is analogous to that confronting the salesman, etc. The test has not, however, been found very successful. Probably the material is too artificial to stimulate interest; perhaps pictures of objects commonly sold would be much better.

Folded Drinking Cup (39). Two simple paper-folding tests are included in the Kuhlmann revision of the Binet-Simon Scale.[1] The particular form of the test described here, however, has, as far as the writers know, been worked with only by the N. Y. Bureau of Analysis. Above ten years of age the test is entirely too simple, but below that level it affords a useful way, without special equipment, of testing ability to follow easy directions. The test is often invalidated, however, by the subject's previous knowledge of how to make such a cup.

Four Detail Drawing (40). The distinctive feature of this test is that it calls for a non-verbal response. The appeal is enhanced by the use of a spirited story and the provision of colored crayons with which to make the drawing. The authors state that success depends on "the attention given and upon auditory, visual and retentive memory."[2] The merit of the drawing is not an intrinsic part of the test, but certainly throws an interesting sidelight on the subject's drawing ability and

[1] 249, pp. 107, 116–117. [2] 40, p. 91.

creative imagination. A simpler story involving only three details has been found useful for children below ten years of age.

The writers believe that the principal ideas involved in this test could be elaborated so as to cover a wide range of abilities and individual variations. One must always remember, however, that the self-conscious attitude which an adult or even an adolescent brings to an exhibition of his drawing ability may change the nature of the test.

Logical Memory (47); **Visual Verbal Memory** (55); **Auditory Verbal Memory** (32); **Ideational Learning** (41); **Learning D** (45). These are differentiated from rote memory tests in that the meaning rather than the actual verbal content is to be reproduced. Such tests presuppose a certain amount of comprehension. This is particularly true of difficult and abstract passages such as those Terman has included at the superior adult level of the Binet-Simon scale.

The Visual Verbal and the Whipple tests are analogous to the ten-year Stanford-Binet passage, but are considerably longer. The first of these always interests the children, but does not seem to discriminate between age groups. This is also true of the Auditory Verbal Test. In the Whipple Test, the paragraph is divided into units, each of which must be recalled for a perfect score. The divisions are so minute that the subject is really required to remember the exact words and not merely the general content. We feel that the aim of the test is thereby defeated.

Pyle's test is freed from this defect. The subject reads the passage (suitable for his age and grade) and is then asked questions concerning what he has read. This is much more similar to the situations that confront us in everyday life.

Learning D has been found too easy above thirteen years of age. If it were doubled in length (as we propose to do) its reliability would be raised from .80 to .90.[1] The test, however, has been included because of the two new features it introduces. In the first place, learning, rather than an immediate memory, is tested. The subject is given three trials and by a comparison

[1] Unpublished study by Jeanette Regensburg.

of his records the examiner can gauge not only his memory powers with logical material but also his rate of improvement in learning. Secondly, the subject is allowed to look at a picture, both while listening to the passage and during his recall. He has, thus, some concrete material to which he may attach associations. This is, we think, a useful and natural way of stimulating learning. The principle involved is often utilized in school texts, etc. Children usually remember the history incidents portrayed in the illustrations in their books, for instance. The use of the moving pictures as an aid to pedagogy is another example of the use of this method.

Memory for Objects (49); **Verbal Directions** (122). The child's interest is readily stimulated by the little toy objects which afford a relief from the meaningless material often employed in memory tests.

The use of objects in testing memory and learning powers has never been adequately studied, but one feels that such a test might have great practical value, particularly in forming a clue for methods in teaching. It is quite possible that children who find it difficult to learn abstract material could be much helped through having work presented first objectively. There is a vast field of research here for students of educational psychology and pedagogy.

Such material may also be easily adapted to use in different fields. For instance, the subject may be asked to group the various objects and then explain his associations;[1] or to use his imagination in constructing a story in which every object shall play some part. Weidensall has used these little objects in her novel directions test. This is much more attractive than the ordinary written directions tests, and readily holds the attention of children and low-grade subjects. Moreover, it approximates concrete situations in everyday life. It is regrettable that this test has never been standardized.

Rational Learning (50); **Multiple Choice** (117); **Arithmetical Series** (1). Peterson claims that the Rational Learning Test

[1] N. Y. Bureau of Analysis, 40, pp. 41–53.

" measures accurately and easily — all one's relevant responses " involving reasoning and memory " to a definite, objective situation." [1]

He distinguishes this test, on the one hand, from learning tests requiring little or no reasoning, *e.g.*, memorizing nonsense syllables; and, on the other hand, from those learning problems consisting of mastery over puzzles, mazes, etc. This test was designed " to see how rational learning is related to learning that must depend wholly on ' trial and error ' efforts." [2]

Peterson obtained (on eighty-one college students) what he considers a significant correlation between rational learning scores and general intelligence as estimated from grades in the psychology course. He believes, moreover, that this test affords an opportunity to analyze individual traits more or less independent of intellect such as " (1) cold rationalistic tendencies; (2) extreme self-consciousness and a disposition to confusing emotional excitement; (3) a tendency to a rough trial-and-error procedure. . . ." [3]

As another " choice reaction " test, Peterson has elaborated the *mental maze*.[4] This differs from the ordinary maze tests in the fact that only the examiner sees the diagram of the maze. The subject reads the instructions which explain the properties of a maze (*i.e.*, blind alleys, etc.) and tell him that wherever two paths are possible each one is designated by a letter. He is to find his way from the outside to the center by the correct choice of one of each pair of letters given him by the examiner. At the end of each trial the subject is told the number but not the places of his errors. The test involving the same maze is continued until the subject has three perfect performances in succession.[4]

Again in this test rational organization is essential. The principle involved is that of always refusing to choose a letter that has previously been wrong, and thus keeping in the forward direction.

All multiple choice tests test the ability to formulate a principle. It is, indeed, a pity that this method, so widely employed in animal psychology, has been little used as a clinical test. Yerkes describes a multiple choice apparatus which " enables

[1] **182**, p. 137.
[2] **180**, pp. 446, 466.
[3] **182**, p. 137.
[4] **140**, pp. 257–280; **181**, pp. 270–300.

the examiner to present to any subject — human or infrahuman, mature or immature, normal, defective or diseased — problems, the solution of which gives opportunity for ideational reaction though not necessarily depending upon it." [1] The author states the belief that " some such procedure as this relational method may profitably be adapted to the needs of the mental examiner as a means of measuring for practical purposes such ideational characteristics of human subjects as number of ideas, their quickness of development and value." [1]

We do not know that the problems suggested by Yerkes for evaluation and standardization have ever been utilized. Brown and Whittell [2] have published results with the multiple choice method on human adults. However, their rather complicated apparatus and the use of electric shocks as incentives to action render it unsuitable for clinical use.

The Arithmetical Series Test measures the ability to make inferences and perceive relationships where mere written numbers instead of a concrete situation are involved.

The Multiple Choice Test, which can be given in many forms, calls for the ability to deduce from a series of experiences the principle which binds them together and explains them. Such deduction, learning, and adaptability are common in our everyday experience. When we find, for example, that the street car, instead of picking us up at Third Street, stops only at Second and Fourth and Sixth, we infer immediately that it stops only at the even numbered streets, and act accordingly. Multiple choice tests would seem to correlate highly with an ability very useful socially. It is to be hoped that, in the near future, these tests will play a prominent part in clinical procedure.

Rote Memory for Words (51). Whipple brings out the contrast between tests of discrete impressions and tests of logical memory where the meaning rather than the exact content is reproduced. The Rote Memory Test belongs to the former category. The kinds and combinations of material possible for testing rote memory are innumerable. We have dealt with the Memory Span for Digits, Memory for Sentences, etc., in another connection.

[1] **151**, pp. 372, 386. [2] **127**, pp. 305–326.

For the Rote Memory Test, Pyle has provided lists of both concrete and abstract words.[1] We have included only the former, since the latter have been very inadequately standardized. Though the distinction between rote versus ideational memory is interesting and probably has practical implications, the value of testing rote memory for words is doubtful.

Visual Designs (52, 123); **Inverted Figures** (113). The Healy Design was devised to provide an alternate for the Binet-Simon designs included in year X of the Stanford revision. The comparative difficulty of the three designs may perhaps be roughly gauged by the norms[2] given below for 157, 159, and 87 fourteen-year-olds (of average intelligence) respectively.

	Design I	Design II	Design — Healy
75 percentile	5	5	5
50 percentile	4	5	5
25 percentile	3	4	4

Terman states that Design I is more difficult than Design II and so has been given the advantageous position at the left. Due to long-standing reading habits, we glance from left to right, rather than vice versa. Design I, therefore, gets more attention than Design II. We cannot agree, however, that the respective position of the two figures has equalized them in difficulty. For our subjects, Design I is still considerably harder. It is true that our results cannot be directly compared with those of Terman, since he allows only three distinctions; success, semi-success, and failure.

Moreover, we cannot fairly compare the results on the Healy Design with the Binet-Simon Designs, because of the divided attention given to the latter. We may say, however, that roughly speaking the Healy Design is slightly easier than Design II and considerably easier than Design I. Of course, for fourteen-year subjects all the designs are far too easy. It is interesting to note that on 262 normal cases (fourteen years of age) we obtained similar and entirely insignificant correlations be-

[1] 58, pp. 14–17.

[2] We have devised a system of scoring for each of these designs on a scale of 1 to 5.

tween Design I and Design II (.12) and Design I and Design — Healy (.19).[1] This leads us to feel that it is impossible to know what is tested when two figures are on one card.

For older subjects, the Ellis designs are more suitable. The first is very simple (a square); the fifth and seventh correspond to the Binet-Simon figures. Designs eight to ten are much harder. The order of difficulty has been established by Goudge, who is working on the standardization of this test.

Terman states that the most important feature of these tests for memory of visual designs is the measurement of the ability for rapid analysis. Since the designs consist of too many lines for the ordinary memory span, it is necessary to group them quickly into some patterns in order to be able to reproduce them.[2] This method is doubtless employed by older or very intelligent subjects, but, in our experience, success at the lower age levels, or by duller subjects, is usually due to good visual memory.

The Ellis Inverted Figures Test does not measure memory, since the subject has the designs always before him. We believe that it measures, to a certain degree, his powers of mental representation. Kuhlmann has included a similar test in his scale at the thirteenth to fifteenth-year level.[3] He says that such a test is intended to " give a task that involves constructive imagination chiefly, intensive directed thinking towards a definite end." [3]

Visual Recognition (54, 53). These are, as far we know, the only individual tests attempting to measure the recognition rather than the recall aspect of memory. The picture test has been little utilized. In fact, no results have ever been published on the post cards now available, and no one has ever established the reliability of this type of test or its practical significance. The material is so different from that found in life situations and educational problems that its value is doubtful, although the measurement of visual recognition would seem to be of great practical value.

[1] From an unpublished study by Regina Stolz, graduate student at Wellesley College.

[2] **256**, pp. 260–261.

[3] **249**, pp. 147–148, 182.

In the Forms Test apparently the same problem is presented in terms of geometrical figures rather than pictures. The relative difficulty of the media of these two tests has never been determined. The Forms Test, of course, allows for a much wider range of performance. Woolley finds a significant difference between the scores made by school children and those who have withdrawn to go to work. The former are consistently superior in this test.[1]

[1] Woolley, **100**, pp. 303–305.

CHAPTER 11

Mechanical and Assembly Tests

Introduction. We have included in this chapter such tests as do not require merely motor coördination, or perception of crude spatial relations, but also the ability to make a synthetic interpretation of separate parts and fit them together. Manual dexterity required is secondary to the constructive imagination necessary to know what is to be made, etc. Under this category are also included such tests as require a certain amount of mechanical knowledge.

McFarlane has made a very thorough investigation of four such tests in her study of " practical ability." She prefers this term to " manual ability ", since, as shown by the test results, " mere motor dexterity is of comparatively small importance for success in the whole performance." [1] She concludes that practical ability constitutes a special ability whose " uniqueness lies in the fact that those persons possessing it in a high degree analyze and judge better about concrete spatial situations than do other individuals who perhaps excel in dealing with more highly abstract symbols." [1]

Toops and Stenquist seem to agree with the idea expressed by McFarlane. The former states that " mechanical ability is probably quite as ' general ' as general intelligence." [2] The value of tests of mechanical and manual aptitude for vocational guidance is apparently very considerable.

Assembly (57); **Mechanical Aptitudes** (63); **Assembly for Girls** (56); **Wheels** (124). Stenquist considers that the assembly tests " deal . . . with the world of objects, — real things, as distinguished from words, and involve both mechani-

[1] **53**, pp. *52*, *56*. [2] **301**, p. 29.

cal skill and abstract mental ability. While their nature is essentially mechanical, they are in no sense trade tests, but should rather be considered tests of general mechanical intelligence and manual aptitude." [1] He finds the self-correlation to be between .6 and .7.[1] Toops also finds the same rather low reliability. He concludes that " in order to have a highly reliable mechanical scale, we must either lengthen the time limits on the present Stenquist test or else add to it tests of other abilities which are important in predicting mechanical aptitude." [2] He feels that the latter is more promising.

The Stenquist test, when used in supplementary Army testing, was given to 14,610 men. It was found to be a very poor indicator of so-called " general intelligence." [3] Toops also found a very low correlation between the Stenquist Assembly and " general intelligence " (as shown by the Army Alpha and other group tests), and concludes that " ' ability with things ' is notably distinct from ' ability with ideas and symbols.' " [2]

This, of course, adds to the value of the test, which is intended to tap abilities not tapped in " general intelligence " tests. Stenquist found that scores in this test correlated .8 to .9 with teachers' ranks in manual training and science.[1] Toops found that a composite of three paper tests failed to predict shop rank as well as the Stenquist Assembly.[2] He feels " reasonably certain that the Stenquist Assembly is to date the most important single test contribution to the measurement of general mechanical ability." [2]

The Mechanical Aptitudes Tests are picture tests and apparently measure the ability to recognize mechanical relationships rather than actually to deal with the concrete material constructively. Stenquist's chief recommendation for this test is the ease with which it may be given and scored.[1] The correlation between the two tests themselves and between the tests and shop ranks seems to vary somewhat.[1] Stenquist states, however, that a high score on the picture tests seems to be an indication of general mechanical aptitude.[1]

The I. E. R. Assembly represents a clever attempt to supply a test for girls analogous to the Mechanical Assembly for boys. To date it has not been adequately standardized, nor is its reli-

[1] **197**, pp. 1, 57–75. [2] **301**, pp. 22–27, 46. [3] **103**, p. 321.

ability known. After correlating it with other tests, its authors conclude that it " measures an ability less closely allied to ability with ideas and success in school work, than to the ability measured by the low-level clerical tests and the Stenquist Assembly." [1]

The Thurstone Wheels is a measure of mental representation, in which the material represents mechanical problems. The test has been very little utilized. The possibilities offered by such material are still unplumbed.

Color Cubes (59); Block Design (96); Color Cubes (97). The Color Cube Test was devised by Maxfield and first standardized in its original form by Hutt. As the originator says, it is particularly valuable for clinical use because it requires only simple material, never fails to evoke interest, reduces the language element to a minimum and may be readily repeated and varied, etc.[2] Hutt concludes that the first three figures are too easy for diagnostic purposes, but that the successful completion of Design 4 or 5 places the subject in a definite group (*i.e.*, superior, average, or inferior, according to the percentile rating of his own age group). She found some correlation between school success and proficiency in the solution of these tests.[3]

Kohs used a modification of this test as a measure of " general intelligence." He substituted seventeen designs for the original five and had the subject copy from designs rather than from models. He found a correlation of .82 between Stanford-Binet age and Block Design age [4] (though, strangely enough, a correlation of only .58 between Stanford-Binet Intelligence Quotient and Block Design age [4]). Block Design scores were also found to correlate more highly with manual training and arithmetic, and less highly with reading and language than any other school subjects.[4] Kohs concludes that " if ' intelligence ' involves the following mental operations: analyzing, combining, comparing, deliberating, completing, discriminating, judging, criticizing, and deciding, then the Block-Design tests may, with justice, be said to call upon the functioning of intelligence, and to that extent they are a measure of that mental capacity.[4] We are

[1] **301**, pp. 22–27, 46.
[2] **196**, pp. 102–104.
[3] **192**, pp. 96–97.
[4] **195**, pp. 181, 183, 175, 190.

inclined, however, to accept Kohs' results rather cautiously since he had only 367 cases ranging from four years to the adult level, no age group being larger than thirty-seven.

Kent has somewhat modified the Kohs material and method, by shortening the test, extending it at the lower level and enlarging the designs so that they are more nearly like the blocks. So far, the revised test has been little worked with. We believe, however, that the modifications should greatly add to its clinical usefulness.

Constructive Ability (60); **Automobile Construction** (58); **Furniture** (107). A few tests have been devised which attempt to measure creative and imaginative powers in construction as differentiated from mere mechanical or manual dexterity. Chief among these is Kelley's very elaborate Constructive Ability Test. Here the material offers scope for the differentiation of a wide range of abilities. The author provides thirty-nine stereoscopic photographs of products of various degrees of excellence in an attempt to ensure objective grading of the results. This is a very clever device, but the nature of the test itself is such that norms must be cautiously approached and interpreted. It is obvious that the number of possible structures is immense and no matter how many photographs are supplied, the subjective judgment of the examiner must always be a factor in the evaluation of the results. Indeed, one of the outstanding contributions of this test is that it throws special light on many qualities as yet unmeasured numerically but of decided value in judging the individual.

Kelley attempts to present a test, the results of which are only slightly influenced by past training, or social environment.[1] We question the validity of any such claim for the constructive ability test in view of the familiarity of children nowadays with construction games and material.

This is also suggested by Dewey, Child, and Ruml, in regard to their Automobile Construction Test.[2] Here constructive rather than creative or imaginative powers is chiefly tested, since the material allows for only two possible constructions, *i.e.*, an automobile, covered and uncovered.

[1] 193, p. 2. [2] 44, p. 23.

Intermediate between the above-mentioned tests is the Furniture Test. Here the fifteen pieces allow for several combinations, at least two of which require all the pieces.

In such tests as the above, important features of the temperamental and emotional make-up of the child may often be observed by his approach to the problem and his method of solution.

Frock and Coat (61); **Wheelbarrow and Cradle** (68). These tests were devised by McFarlane in an attempt to ascertain, (1) whether boys excel in all forms of " construction tests " and (2) whether the nature of the medium or the particular material involved has the greater effect on performance.[1] Although in all the other performance tests she used, McFarlane found a distinct sex difference in favor of boys, it is extremely interesting to note that boys excelled the girls in the wood tests mentioned above only as much as the girls excelled the boys in the garment tests.[1] She concludes in answer to the second question, that the nature of the medium has the greater significance, for in each set of tests there was an object presumably of intrinsic interest to each of the sexes (*i.e.*, the frock and cradle for the girls, and the wheelbarrow and coat for the boys).[1] These results are somewhat analogous to those found with the I. E. R. and Stenquist tests. The work of McFarlane really throws open a wide field of inquiry. Indeed, it is because of this suggestiveness of the tests that we offer them here. Due to their standardization on English children and their utilization (at least in the garment tests) of unfamiliar material, the tests may be in their present form ill adapted to American children.

Manual Dexterity (62). This series is an attempt to get away from the manual tests which for the most part measure mechanical ability, ingenuity, and reasoning powers. As its name implies, this is intended to be a test of manual dexterity alone. In its present construction the test is somewhat cumbersome, but in some form a test like this is certainly needed in the psychological clinic.

[1] 53, pp. 20–21, 41.

Painted Cube (64); Cube Construction (102); Imaged Cube (110). It is interesting and well worth while to precede the first two tests with the third, which requires the subject to think in abstract terms of the material which is afterwards to be presented to him concretely. This is usually considered a very discriminative test of visual imagery. The tester is to be cautioned, however, against interpreting success as necessarily indicative of a special ability in this field. Superior subjects may solve the problem rationally with a minimum of imagery.

The building up of the cubes has taken at least two forms, as described in Tests 64 and 102. The latter was included in the Army Performance Scale. It was found to correlate .633 with Stanford-Binet age scores, and .819 with the whole performance scale.[1] It proved so satisfactory that it was selected to form a part of the short scale.

McFarlane has standardized a slightly different form of the test for ages fourteen and sixteen. At these levels there is a distinct sex difference in favor of boys. McFarlane experimented with a technical group (*i.e.*, children taking a highly specialized course in manual training) and a purely random group. She found that the cube construction test correlated with the Healy Puzzle Box in sixty-six per cent of the former and never in the latter group.[2] She felt justified in concluding, therefore, that these tests contain, in no small measure, the special factors involved in "practical ability." This common factor is the "power to grasp directly spatial, temporal, and qualitative relations between concrete things."[2] Cube construction tests are particularly discriminative in this regard because success depends, not on mere imitation, but on the ability to grasp the spatial relations obtaining between the cubes.

Puzzle Box (66, 65). Healy originally characterized the former test as one that "may bring out abilities or defects in manipulative powers, in the ability to analyze a slightly complicated physical situation, in powers of attention, and continuity of effort."[3]

[1] Yerkes, **103**, pp. 404–405. [2] **53**, pp. 55–56. [3] **49**, p. 18.

The time limit established by Healy for opening the box was five minutes. This has proved much too short, since approximately 30% and 50% of the males and females respectively failed to open the box.[1] Even with a ten-minute time limit, Woolley found that 15% male fifteen-year-olds, and 35% female fifteen-year-olds failed on the test.[2] Moreover, only 40% of the males and 22% of the females were able to close the box within ten minutes.[2] But if one merely wishes to recognize those who have very special ability for this type of work, the five-minute limit for opening the box is enough.

McFarlane found this puzzle box more discriminative of " practical ability " than any of the other tests she used. Of her *technical* subjects, 71.6% exceeded the median of her *random* subjects.[3] She considers that the test " requires good judgment, based upon visual and kinæsthetic clues, and ability to keep the successive steps in mind long enough to indicate the next one." [3]

Woolley selected the Freeman Puzzle Box as a test of mechanical ability for her eighteen-year-old subjects. A five-minute time limit proved much too short, resulting in 30% and 50% failures for males and females respectively.[2]

Perhaps some difficulty in keeping puzzle boxes in order accounts for the limited use that has been made of such tests. We consider, however, that they are extremely valuable for clinical use. We need sufficient experimentation to establish an adequate time limit and more research along the lines laid out by McFarlane.

Tower Test (67). This includes both the Tower and the Nest of Cubes tests, widely utilized in measuring pre-school children. The authors of the test say that it allows the experimenter to study the subject, " from the standpoint of his ability to interpret and follow directions, his precision and mode of attack of a rather delicate task, and his determination to succeed." [4] For results on similar tests with pre-school children, the reader should consult the articles by Woolley and Cleveland,[5] and Stutsman.[6]

[1] Judge Baker Foundation study, as yet unpublished.
[2] **100**, pp. 142–147. [3] **53**, pp. 29, 37. [4] **40**, p. 130. [5] **101**. [6] **93**.

CHAPTER 12

Form Board and Construction Board Tests

Introduction. We have included in this chapter all the form board tests (*i.e.*, tests where the subject fits correspondingly shaped pieces into depressions in a board), and also tests of a similar kind which do not employ the conventional form board. This type of performance test is more widely used clinically than any other. We have found it necessary to include in this manual no less than twenty-three.

Young, commenting upon the form boards, says that they hold an exalted position as head of the list of clinical tests, for which claim he adduces support from studies by Goddard, Norsworthy, Witmer, Sylvester and Wallin.[1]

Success with this type of test seems to necessitate a certain recognition of spatial relations; speed of solution, furthermore, requires a degree of manual dexterity and motor coördination. Popularity is probably due to the recognition that a child is not adequately tested until abilities unrevealed by verbal tests are measured, and to the opportunity this sort of test offers, both for establishing *rapport* with the subject and for noting incidental reactions to a definite objective situation. Our evaluation of form board tests, often expressed in the past, has been recently well stated by Doctor Grace H. Kent. The personality distinctions which she stresses as so important for observation may be made, of course, through the use of many other tests; but the form boards, perhaps because of the unfailing interest they evoke, offer particularly good opportunity for such observations.

Doctor Kent, with special reference to the Worcester form boards, says, " Widely different types of effort have been observed. There is the subject whose form perception is so unerring that he sees at a glance the correct block for each recess

[1] 217, p. 150.

and the correct position for each block, so that the performance is accomplished in minimal time and with little apparent effort. There is the subject who is excessively deliberate and systematic, spending as much time studying the possibilities of each block as if he had been requested to concentrate upon accuracy of movement instead of speed of accomplishment. Contrasting with this type is the subject who works with feverish haste, making little use of his eyes, trying any block in any recess, tossing it aside to try another, coming back to something impossible that he has just tried, matching a block to its correct place but neglecting to insert it, occasionally removing a block that has been correctly placed. Some subjects are stimulated by the increasing difficulty of the tasks, while others are discouraged by it. Some would work all day rather than leave a task unfinished; others are ready to give up as soon as the test presents any real difficulty. Persistence of effort and increasing interest with increasing difficulty are often observed in subjects whose actual achievement is on a very low level.

" It is the process rather than the subject that can be classified according to type. Very few subjects run true to type. The systematic worker may fall back on the trial-and-error method when given a task that is beyond his level. The erratic worker may settle down to something approaching a system when he finds that he cannot accomplish his purpose by random work. It is especially instructive to observe how far the subject takes advantage of something learned by chance, to note the moment at which he grasps the principle of construction of a given board, and to observe what use he makes of it in solving the next board of the series. What the examiner can learn about the subject by studying his development of procedure is in many cases far more significant than any numerical findings." [1] (All this succinctly restates the opinion of many others. Witmer, in particular, has emphasized this point of view.)

" As a standard test for clinical use, the form board should be used with caution. There is at best some interference from chance, and individual variations run high. Low ratings have been obtained from subjects of known superior ability, and high ratings from subnormal subjects. The form board seems to be

[1] Letter from Kent to authors.

a test of special rather than general ability, and it offers more promise as a vocational test than as a test for general intelligence, whatever that may be. More important than the adequate standardization of this form board series among school children is its industrial standardization, in order to determine what kinds of industrial activity correlate well both with speed of performance and with the various types of procedure in form board solution." [1]

Arrow Board (70). The Arrow Board was originally considered an adult test, but the author now believes that it has most discriminative value with children, low-grade adults, and illiterate aliens. Its chief value lies in the way " it treats the subject's ability to differentiate circles, rectangles, and triangles as steps in the development of visual analysis." [2]

Casuist Form Board (71). As an age-level test the Casuist Form Board is not discriminative above ten or eleven years of age. Grace Arthur found this one of the least satisfactory of the tests in her performance scale.[3]

Construction A (72); **Construction B** (73). The extended use of these tests in psychological clinics led us to attempt an adequate standardization. We were forced to conclude, in contrast to several other investigators, that neither Construction A nor B could be considered an age-level test. The extremely small and irregular variation from age to age did not seem to warrant differentiation on this basis.[4] On this account we felt justified in assuming that these were tests of some special ability.

Further statistical work leads us to regard this assumption with suspicion. The element of chance seems to enter so largely into this type of test as to render it unreliable and permits no predictions from an individual's performance. For instance, Morgenthau found the correlation between Construction A and the Knox modification [5] to be — .055 (time).[6] Correlating Con-

[1] Letter from Kent to authors.
[2] Letter from Dunham to authors.
[3] **227**, pp. 395–396.
[4] **208**, pp. 324–338.
[5] This test consists of a diamond-shaped frame and six pieces cut on the bias.
[6] **54**, pp. 38, 45.

struction A with itself (first and second trials) yielded a coefficient of .23 (time).[1] Both Morgenthau and the authors [1] found extremely low correlations between Constructions A and B, .21 and .15 respectively (time).

It is extremely disappointing that even adding several such tests together does not seem to raise the reliability. The average of Constructions A and B with the average of the Knox moron test and Knox modification of Construction A gave a correlation of only .16.[2]

As a measure of general intelligence these tests are no more significant. Between Construction A and Intelligence Quotient (Stanford-Binet) and Construction B and Intelligence Quotient we found correlations of .19 and .27 respectively (first trial time).[1] Morgenthau also obtained low correlations between the Stanford-Binet and the four construction tests (mentioned above) taken together or separately.[2]

In these, as well as in other tests, especially those involving concrete material, the subjective observation of an individual's approach, his method of attack, etc., is always valuable and often highly suggestive. But from the data given above we see no evidence for concluding that by themselves either of these tests is a reliable indication of either " general intelligence " or any special ability. Their use is limited to inclusion in a battery of performance tests where the unreliability of each may be subdued in the total findings.

Construction Puzzles (74). Woolley includes these tests in her scale of mental measurements. She states that she cannot explain their significance but that " whatever they measure it seems unrelated to school grade . . . to a greater extent than any other mental test." [3] The very large proportion of failures even at the eighteen-year level seems to point to an inherent defect in the test or to the employment of an inadequate time limit.

[1] Unpublished data from the Judge Baker Foundation. We are indebted to Regina Stolz, Wellesley graduate student, for the statistical work on these tests.

[2] **54**, pp. 38, 45.

[3] Woolley, **100**, p. 141.

Cylinder (75). This performance test is unique in that the form of the blocks remains constant while the diameter and the height are varied. We do not believe that a difference of a few seconds from age to age is enough to allow a very definite classification of an individual's performance. Still, it is true, as Paschal maintains, that there is a consistent decrease from six years to the adult level. Quantitatively, moreover, the series of trials gives us a reliable index of the individual's psychomotor capacity.[1]

It is from the qualitative aspect, however, that this test is most useful. Jones,[2] Leaming,[3] and Paschal [4] have worked a great deal with it and agree with the originator, Witmer, that, from the standpoint of analytic diagnosis, it is one of the most significant of the performance tests now available. Witmer and these others claim for the test that the subject's mode of attack offers an opportunity to judge his planfulness, " imageability ", his powers of analysis (his grasp of the constant principle upon which the blocks are built), and his powers of distributive attention (an efficient worker will use both hands to great advantage). It is true, however, that, in greater or less degree, these observations can be made on any performance test, but that due to its construction and the relatively large number of pieces it employs, with the consequent number of moves necessary, the Cylinder Test is peculiarly well adapted to this type of analytic judgment.

Diagonal (76). Pintner-Paterson feel that the puzzle nature of the test and the part that chance may play in success or failure render it worthwhile only when used in a group of tests.[5]

Feature Profile (77); **Manikin** (86). Knox considered the Feature Profile one of the most difficult tests of his scale. As used by Pintner and Paterson, however, the norms are not discriminative above eleven years of age.[6] We have found this test unsatisfactory, especially due to the fact that an individual's

[1] **210**, p. 52. [2] **85**, pp. 19–76. [3] **87**, pp. 3–30.
[4] **210**, pp. 5–53; **209**, pp. 54–59.
[5] **57**, pp. 119–121. [6] **57**, pp. 195–196.

performance must be thrown out if the four pieces forming the ear are fitted in without regard for their proper relation to each other.

The Manikin Test has an even smaller range and is not at all discriminative above eight years of age, according to the Pintner and Paterson norms.[1] Johnson found that for her group it was too easy after the age of six years.[2]

Form Board 1 A (79); **Five Figure Board** (78); **Two Figure Board** (90). These were all patterned on the original Seguin Form Board, but were intended to serve in differentiating higher grades of subjects.

The norms for the Five Figure Board are somewhat irregular, especially above twelve years of age. Pintner and Paterson feel that the "puzzle" nature of the test, contributing an element of chance, may account for this.[3] They believe, however, that it has admirably served the purpose for which it was designed.[3]

The Two Figure Board has been found easier than the Five Figure Board. Here also the authors believe that variation in the norms is accounted for by the "puzzle" nature of the board. Above nine years of age the results are irregular. Grace Arthur found this test the least discriminative of any of the performance tests used in her scale.[4]

Form Board 1 C (80); **Form Board 3** (81). Form boards 1 C and 3 are unusual in that the boards are presented to the subject with the depressions partly filled in such a way that several changes must be made before the remaining pieces can be fitted in. Thus, essentially the same problem is presented to each subject. As the originators point out, in form boards of the 1 A type the subject by his first placement may greatly facilitate the final solution, whereas another subject by an equally chance placement may set himself a much more difficult problem.[5]

Moreover, the utilization of the material as in Form boards 1 C and 3 allows for great variety of problems of varying difficulty. The originators have set and standardized three such

[1] **57**, pp. 195–196. [2] **84**, p. 103. [3] **57**, pp. 35, 105.
[4] **227**, pp. 392–395. [5] **201**, p. 26.

problems for Form Board 3. These tests measure particularly the ability to plan. Jones,[1] Leaming,[2] and Johnson [3] consider that, as compared to other form boards, 1 C is more than ordinarily discriminative, especially at the upper age levels.

Form Boards (83). This is a graded series of boards in which the first is easy enough to interest a low-grade subject while the sixth is difficult enough to challenge the most intelligent. This great increase in difficulty is brought about by the very ingenious introduction of bevels, single and double, in varying combinations.

The wide range of possible scores eliminates in great part the factor of chance. As Kent has pointed out, however, errors are not self-correcting. We should like to see the board so modified that it will not be possible for two pieces to appear identical so that a perfectly chance and blind placement may facilitate a subject's success or bar him temporarily from a perfect performance. This criticism is particularly applicable to the large pieces in board 6. Moreover, it is a great pity that the hexagon piece in board 2 should be entirely out of keeping with the other blocks. It is not infrequent to find that a subject will fill all the depressions, except this one, in a few seconds and then spend several minutes fitting in these two pieces.

We have modified the original scoring to permit a greater range and wider discrimination of performance.

In spite of the drawbacks mentioned above, we have found the boards highly satisfactory. They never fail to evoke interest and they surely test the subject's ability to work planfully with concrete material.

Form Board (84, 85). This form board was originated by Seguin as a means of training defective children. It was first used as a mental test by Norsworthy.[4] Since then, many variations of material, method, and interpretation have been introduced. We have discussed in detail only two: the well-known Goddard modification of the Norsworthy board, and the Witmer modification of the Sylvester board. The advantages claimed

[1] 85, pp. 49–50. [2] 87, p. 19. [3] 84, p. 123. [4] 89, pp. 25–26.

for the latter over the more familiar board are that its smaller size permits it to be carried about easily, renders it more like a game for the children, and the extra piece adds to the complexity of the test.

Most of the investigators have rated performance on the basis of the time necessary for its completion. But there is much disagreement as to whether the time of the first trial, the best trial, or the average of all three trials furnishes the most reliable index of ability.

Wallin [1] in an early publication favored the shortest record as the fairest indicator of the individual's best ability. In a later article he gives no reason to believe that his point of view has changed, although, in response to a demand, he presents norms established on the average of the three trials.[2] Sylvester considers the latter most satisfactory in individual cases, but shows that the shortest of three trials is the most reliable method from the statistical standpoint, since it has the lowest variability.[3] After an extended research on all the methods Young concludes: (1) that each of the trials has a definite psychological significance when considered in its numerical order; (2) that the average of the three trials is a meaningless composite of three totally different indices; (3) that the time of the first trial is more significant than any other one record, since it is a " statistical index of a child's form board ability without previous acquaintance or practice on this specific problem." [4]

A great deal has certainly been claimed for this test. Goddard says, " No other test . . . shows us so much about a child's condition in so short a time as this form board." [5] Witmer believes that it is" one of the best tests for distinguishing the feeble-minded child from the child of normal intelligence." [6] Young lists no less than forty-nine functions, capacities, etc., in an attempt to enumerate some " of the more elementary mental and physical factors involved." [7]

Other writers have considered that it tested chiefly one or more of the following: perception and discrimination of forms, manual or constructive ability, motor coördination, the ability to meet new situations, planfulness and learning ability, etc.

[1] 215, p. 88. [2] 213. [3] 212, p. 42. [4] 219, p. 89.
[5] 205, p. 51. [6] 216, p. 247. [7] 217, pp. 151–163.

It is impossible for us to evaluate all these claims. A great deal depends on the manner in which the test is given and the viewpoint from which the results are interpreted.

Mare and Foal (87). Pintner-Paterson say that this test is discriminative up to ten years of age.[1] Healy believes that, except in the case of very young children, the only value of this test lies in its use as an introduction to further testing. Its bright pictures and puzzle-like nature evoke interest and help to create a friendly attitude.

Pintner-Paterson have simplified the original board by gluing the triangular pieces into place. It is true, as they state, that the triangles are not of the same character as the other pieces and render the test very much more difficult. Since the chief value of this board is its attractiveness to young children, this modification appears to be very wise.

Ship (88). This test has some slight discriminative value from five to eleven years of age. It was included in the Army Performance scale in a somewhat modified form. Before the test, the subject was allowed to see the completed picture for ten seconds. The Ship Test was found easier than any other in the battery of tests employed.[2]

Triangle (89); **Adaptation Board** (69). These tests are useful merely for children below eight years of age. In the triangle the element of chance apparently plays a great part in solution. In the other test the possible range of scores is extremely small, and the originator believes that it has distinct value only when included in a scale of tests.[3]

[1] **57**, p. 99. [2] Yerkes, **103**, p. 403. [3] Letter from Goddard to authors.

CHAPTER 13

Other Non-Language Tests

Introduction. We have included in this chapter those tests that did not seem to fall into any of our other categories, however loosely made up. These are grouped together only for purposes of convenience.

Cancellation (91). This rather simple test has been considerably used since 1895 both in the laboratory and the psychological clinic. As Whipple says, " The test is rather remarkable for the variety of forms it has assumed, the variety of names that have been given it, and the divergence of statements as to what it really measures." [1] Cancellation of letters, numbers, words, geometrical forms and symbols in various arrangements and combinations has been employed by different investigators.

The choice of the " a " test for Part II was made because of its common use and the reliability of the norms for children and adults established with it. Moreover, this form is ingenious in that it lends itself to easy scoring and manifold repetition because each letter of the alphabet is included exactly fifty times. The " A " test, which involves less eye strain, does not possess the latter advantage. (It has been standardized by Pintner, who considers it the least satisfactory of all the tests in his Survey.) [2]

Pyle's results, already quoted, like those of other investigators, indicate a marked sex difference in favor of girls, and progressive improvement from age to age. The reliability of all forms of the cancellation test has been found fairly high.[3]

Many statistical investigations have been made in an attempt to ascertain what the cancellation test really tests. On the

[1] 66, p. 305. [2] 56, p. 26. [3] Whitley, 68, p. 75.

whole there is general agreement as to its low correlation with general intelligence. For example, using the "A" test, Wissler [1] found a correlation with class standing of −.09; correlating the same test with estimated intelligence, Simpson [2] found a correlation of .21. After an analysis of this test by the method of partial correlation Garrett and Lemmon concluded that success on the "A" test is "contributed to equally by the marking movement and the recognition of the symbols", but that there were also other unknown factors.[3] Whitley, who experimented with many forms of the cancellation test, concluded that "even as few as two tests of approximately a minute with the "A", "a-t" or geometrical forms test are significant of an individual's ability in visual perception." [4] We feel that not only as a test of visual perception but also in measuring an individual's power of sustained attention and the rapidity of his movements, the cancellation test has a distinct place in the psychological clinic.

Identification of Forms (92). The originators state that they attempted here to develop a test "involving the transfer from a kinæsthetic to a visual impression . . . [and] the type of discrimination and comparison which is common in life." [5] From the standpoint of age differences the norms are, of course, undiscriminative. So little has been done with this test that it is impossible to know whether the originators' aims have been realized.

Maze (93). Porteus states that the tests in this series were designed to examine an individual's "planning capacity, prudence and mental alertness in a new situation of a concrete nature." [6] They were evolved in an attempt to supplement the Binet tests by testing those "temperamental capacities" which determine an individual's success or failure in social adjustment. One of the distinctive features of the maze test is that the subject "is given an opportunity to realize his own errors and by a system of repeated trials to profit by his experience and to readapt his methods." [6] Morgenthau found this test extremely reliable (self-correlation .95).[7] At Vineland

[1] **69**, p. 61. [2] **63**, p. 75. [3] **47**, p. 430. [4] Whitley, **68**, p. 75.
[5] **44**, p. 31. [6] **142**, pp. 5–6, 14–16. [7] **54**, p. 35.

a fairly high correlation was found to obtain between Porteus test age and industrial ability (males .67, females .75).[1] At every age except twelve a decided sex difference [1] has been found in favor of the males. Burt [2] believes that these tests make a useful supplement to other scales, especially " in estimating social as distinguished from educational efficiency."

It is interesting to note that maze tests comprise the bulk of the material used by experimenters in animal psychology.

Slot Maze A (94). The novel material employed in this test serves as a stimulus to the child. There are great time differences and overlappings in successive years. This is a useful test of planfulness and foresight for children ranging from four to ten years of age.

Tapping Test (95). The tapping test is the only definitely psycho-physical test we have included in our manual. We believe that it has a distinct place in any battery of tests used in the clinic. As Garfiel says of the measurement of motor ability, " its practical importance lies chiefly in its immediate usefulness for departments of physical education, and in its . . . significance in vocational guidance." [3]

We have chosen the Whipple-Healy tapping test chiefly on account of the simple material it employs and the brief period of time it consumes. There are, however, innumerable other such tests of motor ability, ranging from " the puncturing of a small square of paper with a pointed stylus to the execution of difficult trilling movements upon telegraph keys." [4]

Many investigators [5] have concluded that there is a negligible correlation between mental and motor ability.

A very low correlation has also been found between the so-called " motor tests " themselves. Muscio concludes from such results that " from the point of view of vocational guidance, the practical conclusion is that . . . motor (vocational) tests

[1] **142**, pp. 5–6, 14–16.
[2] **43**, p. 244.
[3] **223**, p. 1.
[4] Whipple, **66**, p. 131.
[5] Garfiel, **223**, p. 44; Bickersteth, **37**, p. 71; Morgenthau, **54**, p. 40.

for a given ' motor ' occupation must be tests of just those motor capacities that function in that occupation." [1]

Glenn found a somewhat higher correlation between performance on motor tests and on manual tasks than between results on motor tests and academic achievement.[2] Her investigation was only a beginning, however, of what we believe to be a rather neglected field of research. We should very much like to know exactly which motor tests are significant in certain vocations. This can only be done, of course, by studying over a period of years the vocational adjustments of many subjects.

The Whipple-Healy tapping test norms show a marked and continuous development of motor coördination as age increases. Morgenthau found this test to be reliable (self correlation .81).[3]

We were not satisfied with the arbitrary method in scoring of penalizing two for each error. In our own norms speed and accuracy are considered separately. Relation of accuracy to speed when the speed score is much above the average has not yet been determined.

For fuller details in regard to motor tests in general, the reader is referred to the very complete articles mentioned in our bibliography.

[1] **225**, p. 184. [2] **48**, p. 499. [3] **54**, p. 38.

CHAPTER 14

Inadequately Standardized Tests

Introduction. This chapter contains those tests, which, though many of them may be valuable, have up to date been only tentatively standardized, or, in some cases, not standardized at all. We may repeat again that our minimum requirement for adequate standardization has been at least fifty cases at each age. It is regrettable that this chapter should be so large. Some of the tests are, it is true, very new and still in the experimental stage. The majority of them, however, are not being worked with and provide an ample field for further investigation and research.

Color-Naming (98). This is to be distinguished from such tests as the Color-Naming Test in the Stanford revision of the Binet-Simon series (V, 2). In the latter test, the knowledge of the colors is being tested. The Color-Naming Test we discuss here tests the quickness of the subject's reaction time in the case of material with which he is perfectly familiar.

The reaction time for this test is shorter than for any of the other association tests studied by Woodworth-Wells. They find that color-naming is easier than form-naming, another test of this kind.

Garrett and Lemmon have analyzed the Color-Naming Test by the method of partial correlation. They conclude that the interference index (ratio of time on color-naming to color-finding, *i.e.*, calling out all the reds, etc.) is of greatest importance in color-naming scoring. Speed of color recognition is the next most important factor. Speed of speech plays only a minor part.[1]

[1] **47**, pp. 432–438.

Composition — Controlled (99); **Coal Passage Imagination** (3). Winch considers that this Composition Test measures productive imagination. He compared results in this test with what he terms " substance memory " tests, *i.e.*, ideational learning. He concludes that there is a " considerable positive correlation in school children between the two functions or sets of functions employed in memorizing the substance of stories and in inventing stories under given conditions." [1]

In the first of the above tests the subject is provided with clues for a story; in the Coal Passage Imagination Test the subject has to supply the entire material. The latter test undoubtedly affords a freer scope for imagination. The results, however, lend themselves very poorly to numerical scorings. We have worked extensively with this test, and have succeeded, on the basis of one thousand cases, in establishing a qualitative frequency table. Having eliminated totally bizarre and irrelevant responses, it seems fair to consider as least imaginative those responses which are commonest, and as most imaginative those responses which are least frequent. We have thus secured an objective criterion for performance on the qualitative side. The quantitative rating is, of course, the number of ideas given. We have found no adequate method of combining quantity and quality. Perhaps they cannot be added. Or perhaps some degree of quantity has as great or greater value than some degree of quality. We do not pretend to know the relative values.

Chassell has utilized a somewhat similar test in her battery for " originality." [2] Here the subject is asked to make some economic prophecies. The suggestions are graded in proportion to their originality. (Chassell does not state on what basis this was determined.)

Constant Increment (100); **Continuous Subtraction** (101). In regard to such tests, Woodworth-Wells say, " for rigidity of associative control, no experiments surpass those involving the simple arithmetical processes." [3] The Constant Increment Test is a modification of Kraepelin's *Rechenhefte*, described

[1] **149**, p. 124. [2] **128**, pp. 317–328. [3] **170**, pp. 42–46.

in detail by Woodworth-Wells in their original monograph.[1] To our knowledge, very little has been done with this test.

The Continuous Subtraction Test was originally proposed by Kraepelin as a good measure of attention. Sherman has used this test with adults and children and has found that the average errors do not decrease with increase in chronological age or with Intelligence Quotient until sixteen years and a ninety Intelligence Quotient respectively have been reached.[2] She concludes that this test, "for children, is largely a reasoning test rather than an attention test, requiring a certain degree of mental maturity before it can be accomplished. With the increase in mental development, the ability to complete the test increases proportionately; likewise the higher the intelligence quotient, the greater the probabilities are that a subject may perform the test. — Only in the case of the normal adult is the test applicable as an attention test." [2]

In our experience, however, the test has proved very useful as a measure of "mental control." If the arithmetical processes involved are suited to the subject's capacities (*i.e.*, in cases of children, etc., the continuous subtraction of two or three), the test proves valuable in detecting the attentional disturbances so often symptomatic of a psychotic or pre-psychotic condition.

Error Checking (103). All the examples in this test are simple and do not test ability in arithmetic but rather concentration and attention.

This test, which really represents one of the common operations in office work, has been included in many of the clerical tests, *e.g.*, the Thurstone test for office clerks.[3]

Form Board 2 (105); **Form Board 4** (82). Form boards 2 and 4 are similar in that each of the depressions may be filled with the same blocks (three in the former and two in the latter) in varying combinations. Form board 2 has been found too difficult for younger children.[4]

[1] **170**, pp. 42–46. [2] **145**, pp. 386–388. [3] **300**, pp. 248–251.
[4] Dearborn, Shaw, and Lincoln, **201**, p. 24.

Free Association (106, 6). Although many slight variations and modifications have been introduced, there are only two distinct forms of the Free Association Test: the continuous and the discrete. In the former test, emphasis has, on the whole, been laid on the quantitative results, *i.e.*, the rapidity of the subject's associations as indicated in an extended series. The writers believe that this test should be given orally, as the method of writing used by Pyle, for instance, introduces a great variable factor — the speed of writing. This is particularly true with younger subjects. With oral methods, pronounced individual variations are, of course, easily observed. This test has been used qualitatively as an indicator of the subject's interest, habits of thought, etc.[1]

The Kent-Rosanoff method of the discrete form has practically taken possession of this field, because it offers an objective method of evaluating the subject's responses by comparison with elaborate frequency tables. In 1917 Woodworth and Wells stated that they believed that this test would "hold indefinitely its place in the foremost rank among the methods of individual psychology."[2] The originators consider only the content matter of the responses, grouping them into common, individual, and doubtful classes. Other investigators have considered the time of the reaction also highly significant.[3] Kent and Rosanoff both state that the test has no place in the routine schedule of the clinic. "Kent has found the test of no actual use in the study of psychotic subjects, and is strongly opposed to any interpretation of an individual record in terms of the statistical findings, because of the very wide individual variations found among normal subjects."[4] Rosanoff believes that in special cases it is a useful adjunct in the diagnosis of psychotic or psychopathic conditions; the detection of simulation of mental disease or mental deficiency; and the determination of special trends or preoccupations.[5] "O'Connor, of the employment department of the General Electric Company, has found the test useful as a means of selecting persons who are strong in social contacts, and he is compiling frequency tables for an additional series of stimulus words."[4]

[1] **67**, pp. 46–53. [2] **170**, p. 73. [3] Wells, **168**, p. 23.
[4] Letter from Kent to the authors. [5] Letter from Rosanoff to the authors.

Several writers, including T. R. and A. J. Rosanoff,[1] have conclusively shown that children's associations are different from those of adults. On this account Woodrow and Lowell have compiled children's association frequency tables to " serve as a standard in the studies of the mental association of individual children." [2] We may note, in passing, that this test embodies a method in wide use among the psychoanalysts.

Geometrical Objects (108); **Land Section** (114); **Hands** (8); **Spatial Relations A and B** (120); **Floor Plan** (104). To date comparatively little has been done with these tests, although at the present time several investigators are at work with some of them.[3] They all seem to involve visual mental representation, though much work in standardization, intercorrelations, and correlations with objective criteria is necessary to determine what factors are subsumed under the blanket term *visual imagery*.

Hollow Square (109). As we have already shown, tests of the Construction A type are very unreliable because of the variable part which chance plays in their solution. In an effort to obviate this difficulty Lincoln has here given us eight problems to be solved with the same board. These problems range from the very simplest to fairly difficult combinations. It appears to be an exceedingly worth-while test, especially for younger children.

Ink Blot (111). The diagnostic significance of this test is still obscure. This is due partly to the fact that such varying methods have been utilized by the different investigators. Time limits ranging from one minute per blot to all the time the subject wishes, the use of four to twenty ink blots, and directions limiting cards to one position or allowing subject to toy with them at his pleasure render comparison of results impossible.

[1] **166.** [2] **169**, p. 1.

[3] Another extremely difficult test of this kind is "Royce's Ring", fully described by Chassell, **128**, pp. 320–321.

Another factor complicating objective grading is the very nature of the test itself. As in the Coal Passage Test, the difficulty of introducing a method of scoring to take account of both qualitative and quantitative excellence has not yet been surmounted. The value of a number of trite and obvious associations in comparison with one rich in detail and complexity is perhaps indeterminable.

For estimating creative imagination, the qualitative aspects of the individual's associations, though not numerically measureable, may be extremely fruitful. Miss Sharp has made an interesting classification of responses into the constructive, or synthetic type; and the matter-of-fact, analytic type.[1] Such analysis may lead to a better knowledge of the true nature of the processes we are attempting to evaluate. As McGeoch concluded, after finding extremely low correlations between different "imagination" tests, there may be "imaginations and not an imagination."[2]

Instruction-Box (112, 42). The former was devised in an attempt to measure the subject's capacity for following instructions. The artificial element introduced in ordinary verbal directions tests was done away with, and the subject was given a chance to show what he could do with actual concrete material, stimulated by the prospect of opening the box. The situation is similar to one which is often met with in everyday life. In many occupations it is necessary to learn the steps preliminary to opening a safe, cash register, etc. Dewey, Child, Ruml, in experimenting with a very simple box,[3] found it unsatisfactory and advised at least as complex a mechanical construction as the Healy-Hayes box in order to facilitate evaluation and "to make each move depend on the one preceding it."[3]

In the Hayes Instruction Box Test the subject is given written and diagrammatic rather than oral instructions. Woolley finds it "unsatisfactory from the point of view of distribution of the measure."[4]

[1] 62, p. 373.
[2] 137, p. 442.
[3] 44, pp. 31–35.
[4] 100, p. 146.

We feel that the principle involved in these tests is an extremely valuable one which has not yet been adequately worked out.

Memory for Sentences (115). Memory for sentences has been included in the Binet-Simon Scale and its various revisions. As an individual test, however, it has never been standardized. It is a test of the auditory memory span for words. Although in the Whipple Test there are sentences containing the number of syllables standardized for age-levels in the Stanford-Binet Scale, yet it is not known that the norms apply to the former.

Object Completion (118). We have departed somewhat from the original method of giving this test. Heilbronner asked his subjects to describe each picture and to tell the difference between each two consecutive pictures. This does not seem to add anything of distinct value, and considerably complicates the procedure.

This seems to be an apperception test. It allows for grades of ability; thus the fewer the pictures of each series required by the subject to guess the object represented, the better his score. No study has been made to indicate the value of this test for any practical applications.

Peg Design (119). This is a simplification of an old puzzle which employed pegs in all thirty-three holes of the board. It has been found that for younger children it is chiefly a test of rote memory, but older children grasp the idea and reason it out. Besides learning powers it also, in some degree, tests remote memory.

Worcester Form Boards (125). "The Worcester Form Board Series was developed with special reference to the needs of the traveling clinic, and the outfit was made as compact as possible. The first two boards of the Ferguson series served as the basis for the designs of three of the Worcester boards, but were not followed closely." [1]

[1] Quotation from Kent's letter to authors.

Kent and Shakow have constructed a form board series, presenting "a continuous gradation of increasing complexity, each board introducing one new problem in addition to the problems already presented by the boards that stand lower in the series. A failure to solve any board except the second in the Worcester series may safely be taken as an indication that the subject has reached his limit in this test, and repeated failures are not needed to make the test complete.

"The most distinctive feature of the series is that the specific problem presented by each board is repeated at least five times, in order to offset the effect of chance. It is inevitable that chance will be a factor in individual placements, and for this reason it is desirable to have a check on the interference of chance. Each task has been made largely self-corrective, in order to reduce the element of chance and thus to encourage systematic procedure on the part of the subject. Strenuous effort has been made to avoid having any two blocks of a given set sufficiently similar in shape to be easily confused.

"The boards can be presented wholly without language, and the series as a whole is discriminative from the four-year level to that of superior adult, so the test is almost universally applicable. It commands the spontaneous coöperation of the subject in the large majority of cases." [1]

[1] All quotations from Kent's letter to authors.

PART FOUR

OTHER FIELDS OF TESTING

FOREWORD

PART FOUR covers briefly individual scales, composite tests, personality and character tests, vocational and trade tests, educational tests. It is intended merely to give a short descriptive sketch of each. Adequate references for the different fields are to be found in our bibliography.

CHAPTER 15

Individual Scales

Under this classification we consider series or systems of tests which aim to give a single rating of the individual, whether numerically expressed (by age-level, intelligence quotient, or points), by classification (*e.g.*, De Sanctis), or profile (*e.g.*, Rossilimo). They are to be differentiated, on the one hand, from individual tests, which comprise the bulk of this manual, since test scores are blended into a total instead of being considered separately. (In cases where separate norms have been established we have included each test in the manual as well as the scale here.) We have distinguished them on the other hand from the composite tests, discussed later, since they must be administered individually and not in groups.

Concerning individual scales in general, we ourselves look forward to the time when they will be considerably improved from the forms in which they have so far been developed.

1. BINET-SIMON

The Binet-Simon age-scale was devised in 1908, for the purpose of differentiating by some objective criterion normals from defectives in the Paris public schools. It was seized upon eagerly, popularized, and now more than ever occupies a large part in the field of mental testing. As Burt has so well said, for the purpose of estimating intelligence "among children backward in attainments . . . but in other respects forming for the examiner . . . an unknown (quantity) . . . the Binet-Simon scale is unquestionably superior to the unaided judgment of the examiner . . . and there is as yet . . . no other method available, at once surpassing it in simplicity, equalling it in accuracy or approaching it in prestige." [1]

[1] 43, p. 208.

The amount of work that has been done with this scale in its various forms is indeed staggering. The bibliography compiled by Boardman [1] in 1917 contained no less than 358 titles. Since that time doubtless this number has doubled. We shall make no attempt to discuss in detail the history of the scale. This has been adequately taken care of by many writers, including, recently, Pintner [2] and Peterson.[3]

For more ready access to original sources we have enumerated below the chief revisions and their outstanding features.

The separate tests were published by Binet and Simon in 1905,[4] and in 1908 [5] combined by Binet and Simon into an age-scale ranging from three to thirteen years. The 1911 revision [6] was better standardized, extended, and more adequately scaled.

Goddard first introduced the scale in America and in 1911 [7] published a slightly revised version standardized on American children.

In 1915, Yerkes, Bridges, and Hardwick [8] published the Point Scale that goes by their name. This consists of twenty tests, predominantly from the Binet-Simon scale although much of both material and method has been modified. The distinctive feature of the scale is that the tests, instead of being grouped by ages and recorded as either passed or failed, are scored in such a way that the subject obtains credit according to the merit of his replies. It is possible to change the scores into mental age ratings. A correlation of .87 has been obtained between this scale and the Stanford Revision.[9] The Point Scale has not won for itself extensive usage.

In 1923 the Point Scale was revised by Yerkes and Foster.[10] Only slight changes were introduced into the pre-adolescent scale already published, but an infant point scale to be used with children under seven years and an adolescent scale were added. The infant scale consists of twenty-two tests, some of which are identical with the pre-adolescent scale and others which have been taken from the Stanford, etc. The adolescent

[1] **306**, pp. 5–56. [2] **19**, pp. 24–38. [3] **18**.
[4] **231**, pp. 191–244. [5] **228**.
[6] **230**. For translation of this and preceding scales, *see* **172**.
[7] **238**, pp. 56–62. [8] **258**.
[9] Fernald, Hayes, Dawley, **81**, p. 58. [10] **259**.

scale consists of twenty tests provisionally grouped and as yet only tentatively standardized.

By far the best known and most widely used American revision of the Binet-Simon scale is the Stanford, published by Terman in 1916.[1] Terman and his co-workers building upon Goddard's revision, made radical changes in the original tests, and added others. This scale consists of ninety tests (counting alternatives) arranged in age groups, extending from three years to the adult level. More than one thousand cases were employed in its standardization. (We do not propose to enter here into any discussion concerning the merits or demerits of Terman's work. This topic has recently been discussed at length in a very able fashion by Wells.[2])

The popularity of this scale has led to a very inadequate recognition of two other very worthwhile revisions, *i.e.*, the Herring (1922) and Kuhlmann (1922).

The Herring Scale [3] consists of thirty-eight tests, arranged in the form of a point scale in such a way that from four to thirty-eight tests may be given. Some of the material is identical with the Binet, but a great deal is original. The author states that the purpose of this scale is to provide a new series which shall correlate with our present criteria, and which may be used to verify results obtained by other examinations; to allow for more adequate testing at the lower and upper levels; and to offer several short but fairly reliable forms.[4] Up to the present time the scale has been very imperfectly standardized. On the basis of 270 cases, however, Herring obtained a coefficient of correlation of .98 between his scale and the Stanford-Binet.

The Kuhlmann Revision [5] is an age scale ranging from six months through fifteen years. For each age level there are eight tests which are scored according to a system of partial credits rather than by the all or none method. Plant has worked rather extensively with the Stanford and Kuhlmann revisions and concludes that the outstanding feature of the latter is that it tests "mental control", *i.e.*, the "ability to attend to a task over a relatively extended period of

[1] 256. [2] 33. [3] 245.
[4] 244, pp. 172–173. [5] 249.

time."[1] In the cases of the normal children studied by Plant the two Intelligence Quotients were practically identical, while with psychotic children there was a striking difference between the two results. He feels justified in concluding that "definite emotional disturbances are with large precision detected through using the Kuhlmann and Terman scales in such a way as to evaluate the 'mental control' element in the former scale."[1]

We may also mention the two most noteworthy of the foreign revisions, the one by Burt, the other by Treves and Saffiotti.

Burt[2] has retained all the tests in both the 1908 and 1911 scales (sixty-three in number) and added four-digit and six-digit memory span tests. He has so translated and, in part, modified the tests as to adapt them for use with English children. The tests have been standardized on thirty-five hundred cases. Some of Burt's general conclusions as to the values of the scale have been quoted above.

Treves and Saffiotti[3] have very considerably modified the tests and standardized them on about one thousand Italian children. The tests are grouped according to both age and grade. Instead of assigning a numerical rating the subject is designated as defective, average, or superior.

Both the Yerkes-Bridges-Hardwick and Stanford revisions of the Binet-Simon scale have been adapted for use with the blind. The former has been standardized on only one hundred and sixty blind subjects, but results have been sufficiently satisfactory to warrant the following statement by the author, Haines. "These averages, with our instructions and descriptions of the tests, constitute a basis upon which any one may now measure and rate the intelligence of any blind person ten years or more of age."[4]

Hayes and Irwin have standardized a revised version of the Stanford-Binet scale on twelve hundred blind children. They state that their present scale is as yet only tentative. In its final revision, the scale will have six tests for each year, including

[1] **252**, pp. 3–7. The author does not believe that defects of mental control are synonymous with emotional instability, but that "on the whole" in children a defect in mental control is a strong indicator of emotional disturbance, **499**, p. 6.

[2] **43**, pp. 1–209.

[3] Burt, **232**, pp. 365–373. Also *see* Treves and Saffiotti, **257**.

[4] **240**, p. 149. Also *see* **239** and **241**.

year eleven, and alternative tests in several of the age groups. The Stanford revision has been adhered to as closely as possible, substitutions having been made only for those tests which require vision. Irwin and Hayes stress the advantage of being able to compare the blind with seeing children of the same age.[1]

Herderschêe has arranged the Binet-Simon tests for deaf and dumb children. He presents results on eighty-two subjects ranging from three years to seventeen years of age.[2]

2. DE SANCTIS SCALE

A description of this series was published in 1906.[3] The Scale attempts merely to differentiate degrees of defect. The series contains six tests of progressive difficulty, ranging from such a command as, " Give me a ball " (from 5 balls on table), to the question, " When things are far away do they just look smaller or are they really smaller? "

De Sanctis believed he could rate a subject as normal, dull, imbecile, or idiot according to the number of tests he could pass, *e.g.*, if test six is passed subject is normal; if second is not passed subject has very marked mental deficiency.

Martin in 1916 used this test with 362 children. She concludes that the De Sanctis tests " not only indicate the grades of defect, but that they mark grades of development of the normal mind." [4] She regards it as a useful supplement to the Binet Scale.

Drummond attempted to ascertain the value of the De Sanctis tests with English children. He concludes that the tests " afford a rapid means of classifying the mentally defective ", although they cannot " differentiate between the feeble-minded and the normal." He regards the tests as useful in " making a preliminary classification of defectives." [5]

All the investigators seem to agree that the De Sanctis scale may be employed to supplement but not supplant the Binet-Simon scale. It must be remembered, however, that both the investigations described above took place several years ago

[1] Preface to **242**.
[2] **243**, pp. 40–61.
[3] De Sanctis, **234**, pp. 70–83. Also *see* **233**, pp. 498–507.
[4] **250**, p. 110.
[5] **235**, pp. 276–277.

(ten and six years respectively) before performance scales and supplementary tests of various kinds had assumed the importance they have to-day.

3. ROSSOLIMO SCALE

This scale deserves far more attention than has generally been accorded it in this country. Rossolimo [1] attempts to give a complete psychograph of the individual by testing in a variety of ways nine functions which he names as follows: attention, will, recognition and discrimination, memory, comprehension, constructive ability, mechanical ingenuity, imagination and observation and reasoning. The original tests which took three hours to give have been revised by Stevens [2] so that they now require only an hour. Stevens and Parker [3] have done some work with psychopathic cases and feel that the psychograph obtained by the Rossolimo tests is of use in differentiating between some states of mental abnormality, as for example, early cases of dementia praecox and border-line cases of amentia.[3]

As far as we know, no standardization of the entire scale on normal subjects has ever been made. Johnson has worked with the dissected pictures of the original scale and has adequately standardized these on a rather superior group ranging from four to ten years of age. She found this test to be reliable (coefficient of self-correlation of .78) and to have a high correlation with the Stanford-Binet mental age and Pintner-Paterson median age (.81 and .853 respectively).[4]

4. PERFORMANCE SCALES

a. **Army Performance Scale.** This was designed during the World War to test foreigners, illiterates, and those who had failed on the Alpha and Beta examinations. It consists of ten tests as follows: (*a*) Ship (88); (*b*) Manikin and Feature Profile (86, 77); (*c*) Cube Imitation (35); (*d*) Cube Construction (102); (*e*) Form Board 3 (81); (*f*) Memory for

[1] **253**, pp. 249–295. [2] **255**, pp. 128–149.

[3] **251**, pp. 273–293. Parker here gives a complete summary of the original tests.

[4] **253**, pp. 114–115.

Designs; (*g*) Digit Symbol; (*h*) Maze Test (93); (*i*) Picture Arrangement; (*j*) Pictorial Completion II (21). For a short scale, tests *b*, *d*, *f*, *g*, and *h* were utilized.

A correlation coefficient of .84 was found to obtain between performance ratings and Stanford-Binet mental ages. (Subjects were American-born men, most of whom had failed in the Army Alpha or Beta examinations).[1]

The scale " appeared to be as fair to foreigners as to American-born subjects." [1] In summing up its advantages and disadvantages, Yerkes states that " particularly in the short form, it gave satisfactory results ", and with certain improvements which he suggests, " could be made a fairly satisfactory intelligence scale, both for literate and illiterate subjects." [1]

b. **Arthur Performance Scale.** This consists of the following eight tests: Cube Imitation (35); Form Board (84); Two Figure Board (90); Casuist Form Board (71); Manikin and Feature Profile (86, 77); Mare and Foal (87); Pictorial Completion I (20); and Block Design (96). The discriminative value of each test has been statistically determined and together these make up the point values of the scale.

Arthur states that, although the scale is at present in a somewhat tentative form, it has proved a useful adjunct to the usual written tests.[2]

c. **Gaw Performance Scale.** This consists of fourteen Performance tests as follows: Pictorial Completion (20, 21); Manikin (86); Feature Profile (77); Cube Construction (102); Form Board (105, 84); Maze (93); Cube Imitation (35); Adaptation (69); Substitution; Triangle (89); Diagonal (76); Construction A (72).[3] These tests proved applicable to English children and Gaw translated the scores into mental age norms. The averages of those scores correlated poorly with the Stanford-Binet. She concludes " that performance tests measure intelligence in somewhat different terms than those in which it is measured by such tests as the Binet-Simon Scale." [3]

d. **Knox Scale.** The first performance scale was used by Knox to test immigrants at Ellis Island. This consists of sixty-

[1] Yerkes, **103**, pp. 402–407.
[2] **227**, pp. 390–416.
[3] **237**, pp. 375–377, 392. Also *see* **236**.

five tests (including several which are repeated at many age levels) very roughly classified into mental age groups ranging from three to thirteen years.[1] At the present time this has chiefly historical value, since the tests were not standardized and only very crudely scaled. However, other performance scales have borrowed widely from the tests embodied in the Knox scale.

e. **Pintner-Paterson Performance Scale.** Because of its adequate standardization, this scale is particularly worthy of note. The tests are all standardized individually and all but one (a particular form of the Substitution Test) have been included in the manual part of this book. (*See* tests 87, 84, 78, 90, 71, 89, 76, 72, 86, 77, 88, 20, 69, 35.) On the basis of the upper 75 percentile for each age Pintner-Paterson are able to assign a mental age to a performance on any of the fifteen tests. A median mental age on the whole scale may thus be computed. The method they used is very flexible, since it allows for the discarding of any test that is not considered valuable, and the addition or substitution of any adequately standardized test. Pintner-Paterson also offer a tentative point scale and data for rating the performance according to the percentile method.

Buford Johnson has worked extensively with this scale and has found a very high reliability coefficient (correlation between first and second testing .97) and a very significant correlation between the Pintner-Paterson median age and the Stanford-Binet mental age scores (.83).[2] We must bear in mind, however, that the children Johnson worked with were, for the most part, below ten years of age. There is a question whether the above results would hold good for older children or adults.

f. **Universal Performance Scale.**[3] This is a performance scale designed in such a way as to dispense "with the use of language" and so to be capable of application "to any individual whatever, irrespective of his race, nationality, or culture."[4]

[1] **247**, pp. 741–747. [2] **84**, p. 107.

[3] An International Group Mental Test has recently been devised by Dodd, **262**. His Form A contains 503 problems. A rotator device replaces pencil and paper. Form B contains 400 problems and 3500 pictures. Many comparative studies with White, Negro, Indian, and other racial and national groups are in progress.

[4] Squires, **254**, preface.

This scale consists of fourteen tests which take about three and one fourth hours to administer. All instructions are given in pantomime; the point-scale method is followed for scoring.

Among other tests are modifications of the Painted Cube (64); Hands (8); Cube Imitation (35) — a four-bar xylophone is employed instead of cubes; Cube Piles, similar to (102). The scale has been very recently developed and as yet no norms have been established. The separate tests themselves are only provisionally scaled.

5. OTHER SCALES

a. **Maturity Scale — Dewey-Child-Ruml.** This consists of the following tests for both boys and girls: Comprehending Questions, Hard Definitions (Yerkes-Bridges-Hardwick, tests 15, 19), Threading Needles, Cancellation. For boys alone: Automobile Construction (58); Card Sorting (34, note 2); Problem Box. For girls alone: Resisting Suggestions, Dissected Sentences (Yerkes-Bridges-Hardwick, tests 11, 18).

These tests were selected because of their high correlation with chronological age and with them the authors have constructed what they term a " maturity scale ", " not because it attempts to measure maturity, but because it states the position of any child in its performance with reference to the normal performance of children of the same age." [1] Regression equations are given by which the subject's maturity index and also the normal maturity index for his age may be determined.

b. **Woolley Scale of Mental Ability.** This includes Cancellation (91, note 2); Substitution (38, note 2); Digit Memory Span (37); Completion of Sentences; Opposites (17, note 2); Mutilated Text (10, note 2); Construction Puzzles (74); Puzzle Box (65, 66); Instruction Box (42); Visual Recognition (53); Aussage; Hard Directions (24, note 2).

By comparison with the norms a percentile rank can be obtained for a subject's performance on each test and his average percentile rank may be directly compared with reference to other subjects.

Woolley believes that this scale has proved to be discriminative in testing native ability as distinguished from educational

[1] 44, pp. 116–117.

and environmental influences. From a study of 760 school children and 1513 working children (a substantial proportion of whom were tested five times) she cites the following points in support of this claim. The correlation between ability in mental and physical tests (for the most part physical measurements) from year to year was found to be fairly high, particularly at the upper levels, despite the fact that at these levels the physical tests remained unchanged while the mental series differed. In the second place, she found a higher correlation between test results and the school grade for eighteen-year-olds (who had been out of school for four years) than for fourteen-year-olds (who were just leaving school). In the third place, a very low correlation was found between mental test results and home level as estimated under five categories of conditions assigned different values.[1]

[1] 100, pp. 721–723.

CHAPTER 16

Composite Group Intelligence Tests [1]

Up to 1917 practically all psychological examinations had been conducted individually. Upon our entrance into the World War, however, with the proposed psychological testing of nearly two million recruits, a method more economical of time became imperative. Some of the country's foremost psychologists met at Vineland and proceeded to construct the Army Alpha and Beta tests.[2] These group tests proved so successful that many others were devised to suit the needs of schools, colleges, etc.

Group tests are usually printed in the form of a booklet and contain from four to twelve tests, such as opposites, analogies, word completion, cancellation, directions, information, etc. They may be roughly classified into verbal and non-verbal tests, well illustrated by Alpha and Beta already mentioned. Indeed the latter was devised for the express purpose of testing illiterate subjects. Group tests may be classified, moreover, with reference to the ages to which they apply. We may mention, as being devised for the kindergarten and lowest grades, the Rhode Island Test,[3] the Pressey Primer Scale,[4] the Kingsbury Primary Group Intelligence Test; [5] for the elementary grades, the Haggerty Intelligence Examination, Delta 2,[6]

[1] We may stress again the distinction between the material of this chapter and that of Part II. Many of the tests in Part II may be given by the group method; even though some of them are paper tests they are all given separate scores; a combined rating is never utilized.

[2] Yoakum, Yerkes, **72**.

[3] Bird, **260**, pp. 357–463.

[4] Pressey, L. W., **265**, pp. 285–294; **266**, pp. 305–314.

[5] Published by Public School Publishing Co., Bloomington, Ill.

[6] **263**, pp. 257–277.

the Illinois Examination I,[1] the National Intelligence Test;[2] for high school grades, the Miller Mental Ability Test[3] and Terman's Group Test of Mental Ability;[4] for college students, the Roback Mentality Tests for Superior Adults[5] and the Thorndike Intelligence Examination.[6] These tests and forty or fifty similar ones[7] are in use throughout the country.

The value of such tests cannot, of course, be denied. Whereas by the method of individual testing, perhaps two hours is necessary to give a minimum schedule to one subject; by the group method this time suffices for several hundreds. Moreover, the tests are so constructed that they can be administered by any teacher and the separate tests scored and the final rating obtained by any clerical assistant. The very facility of the method is at once its lure and its danger. These tests are undoubtedly useful in a preliminary classification or selection of certain individuals for further testing, but they can never be the final word on an individual's ability. So many factors enter into a subject's performance, distractibility, emotional disturbance, slow reaction time, unwillingness to coöperate, etc.; these and many other observations most important for gaining knowledge of a person's abilities and personality traits may be made by a trained examiner during individual testing but not in a group examination. In the comparison of groups and school systems the group method is approximately valid, since with very large numbers the errors tend to balance each other. As Pintner points out in this connection, "survey tests are not intended for accurate individual estimation of intelligence, but rather for rough measurements of the mentality of groups."[8]

We cannot better sum up our own views than to quote Whipple's statement on this topic made twelve years ago. "On the whole, and especially when careful analytic work

[1] Buckingham, Monroe, **261**, pp. 521–532.
[2] Whipple, **269**, pp. 16–31.
[3] Miller, **264**, pp. 189–222.
[4] Published by World Book Co. [5] **267**.
[6] **268**, pp. 329–337.
[7] For splendid annotated bibliographies *see* Whipple, **313**, pp. 93–113; Freeman, **8**, pp. 181–190.
[8] Pintner, **56**, p. 8.

is contemplated, the group method . . . is out of place. . . . The objection that individual work takes too much time is, as one psychologist has put it, as laughable as would be the defense of a chemist that he had distilled several different fluids in the same flask without washing it — ' to save time.' " [1]

[1] 66, p. 8.

CHAPTER 17

Educational Tests

Within the last few years at least four books [1] have been published which are largely or entirely devoted to a discussion of educational tests and measurements. From 1910, when Thorndike [2] published the first real educational scale, educational tests have multiplied to such an extent that a recent publication, 1926, of the World Book Company, lists no less than 486 titles of tests for use in schools. To give some idea of the field covered, we have enumerated below one reference for each of the most common school subjects, but we do not maintain that these are superior to many others in this field.

Handwriting — Ayres' Handwriting Scale.[3]
Arithmetic — Courtis' Standard Practice Test.[4]
Oral Reading — Gray's Oral Reading Test.[5]
History — Van Wagenen's History Scales.[6]
Geography — Hahn-Lackey Geography Scale.[7]
Spelling — Ayres' Spelling Scale.[8]
Composition — Thorndike's English Composition.[9]
Grammar — Starch's English Grammar Tests.[10]
Algebra — Douglass' Diagnostic Tests for Elementary Algebra.[11]
Geometry — Minnick's Geometry Tests.[12]
Latin — Henmon's Latin Tests.[13]

[1] Hines, **276**; McCall, **303**; Monroe, DeVoss, Kelly, **279**; Pressey, **20**.
[2] **282**, pp. 83–175.
[3] **271**, p. 607.
[4] **273**.
[5] **108**.
[6] **283**.
[7] Lackey, **277**.
[8] **270**.
[9] **281**.
[10] **280**.
[11] **274**.
[12] **278**.
[13] **275**.

CHAPTER 18

Personality and Character Tests

This is a comparatively new field of inquiry that, nevertheless, has assumed such proportions in the last few years that we find it extremely difficult even to summarize the tests. In a recent article, May and Hartshorne enumerate about one hundred tests,[1] although they omit all the numerous rating schemes of character evaluation and all questionnaires, and even within the group of tests employing objective methods so limit themselves as to exclude "the 'association' tests, the physiological tests, tests of motor ability, and tests of information." [1]

There are now tests aimed at measuring (1) personality traits, *e.g.*, the Downey test for speed of decision; [2] (2) interests and attitudes, *e.g.*, Watson's Test of Public Opinion; [3] (3) emotions, *e.g.*, the Pressey X–O Tests; [4] (4) moral judgment, *e.g.*, May and Hartshorne's recognition test for honesty; [5] and many other qualities.

The reader is referred to a very excellent bibliography of 196 titles, prepared by May and Hartshorne,[6] covering the literature of the last six years.

[1] 286, pp. 45–67.
[2] 284.
[3] 288.
[4] 287, pp. 55–64.
[5] 285.
[6] 316, pp. 403–411.

CHAPTER 19

Vocational and Trade Tests

It is only during the last fifteen or twenty years that psychology has played any significant part in business or industry. Trade tests were first developed on a large scale during the World War to "effect the proper placement of the millions of men entering the Army from civil life." [1] The plan was to discover interest and knowledge as well as experience in the various trades, and verbal, picture, and performance tests were utilized, the latter being largely actual operation of the trade for a brief period of time.

Mental tests for specific vocations have not as yet been widely developed. More frequently the "job" is analyzed in an effort to ascertain what capacities an individual must possess to be successful. Then tests are selected that aim at measuring the needed qualities. For the most part, batteries of tests are utilized, the best known of these being the so-called Thurstone Clerical Test,[2] the I. E. R. General Clerical Test,[3] and the O'Rourke Clerical Aptitude Test.[4] Common procedure at the present time is to give a number of tests, and on the basis of the findings to determine within broad limits the kind of work for which the individual is best fitted.

In 1922 Kornhauser [5] summarized a list of one hundred and eighty-eight references to trade and vocational tests. Chapter 15 in Freeman's "Mental Tests" [6] discusses this field. We may also refer to articles and books listed under the special heading in our bibliography.[7]

[1] 296, p. 2.
[2] 300.
[3] Toops, 301, pp. 63–99.
[4] Unpublished.
[5] 293, pp. 192–229.
[6] 8, pp. 399–426.
[7] 289–300 inclusive.

PART FIVE

APPENDIX

KEY TO ABBREVIATIONS

American Journal of Insanity	AmJIn
American Journal of Psychiatry	AmJPsychiatry
American Journal of Psychology	AmJPs
Archives of Psychology	ArPs
British Journal of Psychology	BrJPs
Columbia Contributions to Education	ColConEd
Columbia Contributions to Philosophy and Psychology	ColConPhPs
Comparative Psychology Monographs	CoPsM
Journal of Abnormal and Social Psychology	JAbSoPs
Journal of Applied Psychology	JApPs
Journal of Comparative Psychology	JCoPs
Journal of Delinquency	JDel
Journal of Educational Psychology	JEdPs
Journal of Educational Research	JEdR
Journal of Experimental Pedagogy	JExPed
Pedagogical Seminary	PedSem
Psychological Bulletin	PsB
Psychological Clinic	PsC
Psychological Monograph	PsM
Psychological Review	PsR
School and Society	ScSo
Teachers' College Record	TCRec
Training School Bulletin	TrScB

BIBLIOGRAPHY

I. Mental Abilities and Testing in General

1. Ballard, P. B. "Mental Tests." London, Hodder and Stoughton, 1920.

   Discusses in a general way and in an interesting fashion mental testing in general, and in particular Burt's revision of the Binet-Simon tests and Burt's Reasoning Tests.

2. Bronner, A. F. "Apperceptive Abilities." PsR, 1921: pp. 270–279.

3. Bronner. "Attitude as It Affects Performance of Tests." PsR, 1916: pp. 303–331.

4. Bronner. "The Psychology of Special Abilities and Disabilities." Little, Brown 1917.

   An analysis, illustrated by case studies, of the abilities and disabilities underlying social and educational maladjustment.

5. Buckingham, B. R., *et al.* "Intelligence and its Measurement: A Symposium." JEdPs, 1921: 12, pp. 123–147; 195–216; 271–275.

6. Franz, S. I. "Handbook of Mental Examination Methods." Macmillan, 1920.

   Description of tests of sensation, motor-activity, attention, memory, association, and general intelligence, for use by psychiatrists.

7. Freeman, F. N. "Experimental Education." Houghton, Mifflin, 1916.

   A manual written from the viewpoint of applied psychology, for laboratory use.

8. Freeman. "Mental Tests." Houghton, Mifflin, 1926.

   Historical and descriptive account of "all the important types of mental tests," but no specific tests are given in detail.

9. Gesell, Goddard, Wallin. "The Field of Clinical Psychology as an Applied Science: A Symposium." JApPs, 1919: pp. 81–95.

10. Habermann, J. V. "The Intelligence Examination and Evaluation." PsR, 1916: pp. 352–379.

11. Hall, G. S. "Practical Applications of Psychology as Developed by the War." PedSem, 1919: pp. 76–89.

12. Hart, B., and Spearman, C. "General Ability, Its Existence and Nature." BrJPs, 1912: pp. 51–84.

13. Healy, W. "The Newer Psychiatry. Its Field — Training for It." AmJ Psychiatry, 1926: 5, pp. 391–398.

14. Hines, H. C. "Measuring Intelligence." Houghton, Mifflin, 1923.

A very brief résumé of the aims, principles, problems, and progress of the measurement of intelligence.

15. Hollingworth, L. S. "Special Talents and Defects." Macmillan, 1923.

Chiefly a discussion of proficiency or lack of proficiency in school subjects.

16. Kent, G. "Combination Mental Test for Clinical Use." JApPs, 1923: pp. 246–257.

17. Miner, J. B. "Deficiency and Delinquency: An Interpretation of Mental Testing." Warwick and York, 1918.

An attempt to analyze, particularly in the light of the results of mental tests, the deficient and the delinquent.

18. Peterson, J. "Early Conceptions and Tests of Intelligence." World Book Co., 1925.

A comprehensive history of mental testing up to and including the Stanford-Binet.

19. Pintner, R. "Intelligence Testing." Henry Holt, 1923.

A short history of mental testing and description of the various types of tests, together with a summary of the results of testing various groups, *e.g.* the Feeble-Minded, the Dependent, the Deaf, the Employee.

20. Pressey, S. L. and L. C. "Introduction to the Use of Standard Tests." World Book Co., 1922.

A brief discussion of the use of mental tests, and a description of certain educational and intelligence tests, together with suggestions for their application.

21. "Psychological Tests of Educable Capacity." London, H. M. Stationery Office, 1924.

22. Richardson, C. A. "Methods and Experiments in Mental Tests." London, Harrap, 1922. (Also published by the World Book Co.)

Replies to the critics of mental testing and offers a theoretical discussion of the practical utility of tests.

23. Seashore, C. E., *et al.* "Mental Tests: A Symposium." JEdPs, 1916: pp. 229–240; 278–286; 348–360.

24. Skaggs, E. B. "Elementary Text Book of Mental Measurements." Ann Arbor, Mich., G. Wahr, 1923.

A very short and rather inadequate summary of the field of mental measurements.

25. Stern, W. "The Psychological Methods of Testing Intelligence." Warwick and York, 1914.

Chiefly of historical value.

26. Strasheim, J. J. "A New Method of Mental Testing." Warwick and York, 1926.

The constitution of tests from the point of view of a theory of intelligence propounded by the author.

27. Sylvester, R. H. "Clinical Psychology Adversely Criticized." PsC, 1913: pp. 182–188.

28. Terman, L. M. "The Intelligence of School Children." Houghton, Mifflin, 1919.

Description of results of testing school children with the Stanford-Binet, especially from the viewpoint of illustrating individual differences.

29. Terman. "The Mental Test as a Psychological Method." PsR, 1924: pp. 93–117.

30. Thorndike, E. L. "Measurement of Intelligence — The Present Status," PsR, 1924: pp. 219–252.

31. Thorndike, Woody, Trabue, and McCall. "Standard Tests and Their Use: A Symposium." TCRec, 1924: pp. 93–116.

32. Wallin, J. E. W. "The New Clinical Psychology and the Psycho-Clinicist." JEdPs, 1911: pp. 121–132; 191–210.

33. Wells, F. L. "Mental Tests in Clinical Use." World Book Co., 1927.

An evaluation of methods and tests based on the author's long experience as director of a psychiatric clinic. Much valuable illustrative material.

34. Whipple, G. M. "Endowment, Maturity and Training as Factors in Intelligence Scores." Scientific Monthly, 1924: pp. 496–507.

35. Wylie, A. T. "A Brief History of Mental Tests." TCRec, 1922: pp. 19–33.

36. Young, K. "The History of Mental Testing." PedSem, 1924: pp. 1–48.

II. Data with Groups of Individual Tests

A. The Evaluation of the Tests

37. Bickersteth, M. E. "The Application of Mental Tests to Children of Various Ages." BrJPs, 1917: pp. 23–73.

38. Brigham, C. C. "Two Studies in Mental Tests." PsM, 1917: No. 1.

39. Bureau of Analysis and Investigation. "Eleven Mental Tests Standardized." Albany, N. Y., Eugenics and Social Welfare Bulletin, No. 5, 1915.

40. The same. "Performance Norms for Thirteen Tests." Bulletin No. 8, 1917.

41. Burt, C. "Experimental Tests of General Intelligence." BrJPs, 1909: pp. 94–177.

42. Burt. "Experimental Tests of Higher Mental Processes and Their Relation to General Intelligence." JExPed, 1911: pp. 93–112.

43. Burt. "Mental and Scholastic Tests." London, King & Sons, 1921.

Very scientific, detailed account of Burt's revision of the Binet-Simon scale, supplementary intelligence and educational tests, very elaborate statistical data, and comments on psychological testing in general.

44. Dewey, Child, Ruml. "Methods and Results of Testing School Children." Dutton, 1920.

This contains a detailed description of several physical and mental tests, together with norms obtained on Jewish children.

45. Ellis, F. W., and Bingham, A. T. Seventh Annual Report of New York Probation and Protective Association, 1915.

46. Fretwell, E. K. "A Study in Educational Prognosis." Co ConEd, 1919: 99.

47. Garrett, H. E., and Lemmon, V. W. "Analysis of Several Well-Known Tests." JApPs, 1924: pp. 424–438.

48. Glenn, I. "A Report on the Correlation of Psychological Tests with Academic and Manual Subjects." JEdPs, 1922: pp. 496–500.

49. Healy, W., and Fernald, G. "Tests for Practical Mental Classification." PsM, 1911: No. 2.

50. Holley, C. F. "Mental Tests for School Use." Bureau of Educational Research, Bulletin No. 4, University of Illinois, 1920.

51. Johnson, B., and Schriefer, L. "A Comparison of Mental Age Scores Obtained by Performance Tests and the Stanford Revision of the Binet-Simon Scale." JEdPs, 1922: pp. 408–417.

52. Johnson, R. H., and Gregg, J. M. "Three New Psychometric Tests." PedSem, 1912: pp. 200–203.

53. McFarlane, M. "A Study of Practical Ability." BrJPs, Monograph, 8, 1925.

54. Morgenthau, D. R. "Some Well-Known Mental Tests Evaluated and Compared." ArPs, 1922: 52.

55. Neterer, I. M. "A Critical Study of Certain Measures of Mental Ability and School Performance." Warwick and York, 1923.

Comparative study of certain intelligence and educational tests and their value for educational prognosis.

56. Pintner, R. "The Mental Survey." Appleton, 1918.

Eight tests given to over 3000 school children. Results and evaluation of an educational survey.

57. Pintner, and Paterson, D. "A Scale of Performance Tests." Appleton, 1917.

A scale of performance tests. Description, standardization, and evaluation of the tests.

58. Pyle, W. H. "The Examination of School Children. A Manual of Directions and Norms." Macmillan, 1917.

A manual of certain tests which may be administered in groups.

59. Pyle. "Nature and Development of Learning Capacity." Warwick and York, 1925.

A description of six of the author's tests for learning ability, together with a comparative study and interpretation, and a resulting theory of learning.

60. Rosenow, C. "The Analysis of Mental Functions." PsM, 1917: No. 5.

61. Rugg, H. O. "The Experimental Determination of Mental Discipline in School Studies." Warwick and York, 1916.

Effect upon mental proficiency produced by a course in descriptive geometry.

62. Sharp, E. "Individual Psychology: A Study in Psychological Method." AmJPs, 1899: pp. 329–391.

63. Simpson, B. R. "Correlations of Mental Abilities." ColConEd, 1912: 53.

64. Squire, C. R. "Graded Mental Tests." JEdPs, 1912: pp. 363–380; 430–443; 493–506.

65. Terman, L. M., and Chamberlain, M. B. "Twenty-Three Serial Tests of Intelligence and Their Intercorrelations." JApPs, 1918: pp. 341–354.

66. Whipple, G. M. "Manual of Mental and Physical Tests." Vol. 1. Warwick and York, 1914.

An exhaustive compilation of physical and mental tests, together with the results of the investigations up to 1915. The pioneer work in this field.

67. Whipple. "Manual of Mental and Physical Tests." Vol. 2. Warwick and York, 1915.

68. Whitley, M. T. "An Empirical Study of Certain Tests for Individual Differences." ArPs, 1911: 19.

69. Wissler, C. "The Correlation of Mental and Physical Tests." PsM, 1901: No. 6.

70. Worthington, M. R. "A Study of Some Commonly Used Performance Tests." JApPs, 1926: pp. 216–227.

71. Wyatt, S. "The Quantitative Investigation of Higher Mental Processes." B JPs, 1913: pp. 109–133.

72. Yoakum, C. S., and Yerkes, R. M. "Army Mental Tests." Holt, 1920.

A summary of the psychological tests used in the Army.

B. The Differentiation of the Groups

73. Abelson, A. R. "The Measurement of Mental Ability of 'Backward' Children," BrJPs, 1911: pp. 268–314.

74. Anderson, H. W., and Hilliard, G. H. "The Standardization of Certain Mental Tests for Ten-Year-Old Children." JEdPs, 1916: pp. 400–413.

75. Baldwin, B. T., and Stecher, L. I. "The Psychology of the Pre-School Child." Appleton, 1924.

Physical and mental development of normal and superior children 2 to 6 years of age.

76. Bayley, N. "Performance Tests for Three, Four and Five Year Old Children." PedSem, 1926: pp. 435–454.

77. Bell, C. "Mental Tests and College Freshmen." JEdPs, 1916: pp. 381–399.

78. Bingham, W. V. "Some Norms of Dartmouth Freshmen." JEdPs, 1916: pp. 129–142.

79. Book, W. F. "The Intelligence of High School Seniors." Macmillan, 1922.

State wide survey of Indiana High Schools with comparison of rural and city children, etc.

80. Carothers, F. E. "Psychological Examinations of College Students." ArP, 1922: 46.

81. Fernald, Hayes, Dawley. "A Study of Women Delinquents in New York State." Century Co., 1920.

Contains four chapters relating specifically to the psychological examination of this group, with conclusions as to its relation to other groups.

82. Gesell, A. "The Mental Growth of the Pre-School Child." Macmillan, 1925.

Survey of behavior of infants and young children physically and psychologically.

83. Huey, E. B. "Backward and Feeble-Minded Children." Warwick and York, 1912.

"Clinical studies in the psychology of defectives, with a syllabus for the clinical examination and testing of children."

84. Johnson, B. J. "Mental Growth of Children." Dutton, 1920.

Results of investigations extending over five years, concerning the relation of mental to physical growth in children under 13 years of age.

85. Jones, A. M. "An Analytical Study of 120 Superior Children." PsC, 1925: pp. 19–76.

86. King, I., and McCrory, J. "Freshman Tests at State University of Iowa." JEdPs 1918: pp. 32–46.

87. Leaming, R. E. "Tests and Norms for Vocational Guidance at the 15-Year-Old Performance Level." Thesis, University of Pennsylvania, 1923.

88. MacPhail, A. H. "The Intelligence of College Students." Warwick and York, 1924.

Survey of methods of testing for college entrance, with particular reference to Brown University.

89. Norsworthy, N. "The Psychology of Mentally Deficient Children." ArPs, 1906: 1.

90. Rogers, A. L. "Mental Tests as a Means of Selecting and Classifying College Students." JEdPs, 1920: pp. 181–192.

91. Schmitt, C. "Standardization of Tests for Defective Children." PsM, 1915: No. 3.

92. Stenquist, Thorndike, Trabue. "The Intellectual Status of Children Who Are Public Charges." ArPs, 1915: 33.

93. Stutsman, R. "Performance Tests for Children of Pre-School Age." Genetic Psychology Monograph, 1926, No. 1.

94. Sunne, D. "The Relation of Class Standing to College Tests." JEdPs, 1917: pp. 193–211.

95. Thurstone, L. L. "Mental Tests for College Entrance." JEdPs, 1919: pp. 129–142.

96. Wagoner, L. C. "The Constructive Ability of Young Children." University of Iowa Studies, 1925; 3, No. 2.

97. Wallin, J. E. W. "Experimental Studies of Mental Defectives." Warwick and York, 1912.

Report of administering 1908 revision of Binet-Simon tests to a colony of 300 epileptics.

98. Weidensall, J. "The Mentality of the Criminal Woman." Warwick and York, 1916.

A comparative study of the results of the application of selected physical and mental tests to reformatory women and working girls.

99. Whitchurch, A. K. "Psychological Norms Among University Freshmen." JApPs, 1921: pp. 318–339.

100. Woolley, H. T. "An Experimental Study of Children." Macmillan, 1926.

An extensive comparative study of the results of many physical and mental tests applied to working and school children 14 to 18 years of age.

101. Woolley, and Cleveland, E. "Performance Tests for 3, 4 and 5 Year Old Children." JExPs, 1923: pp. 58–68.

102. Woolley, and Fischer, C. R. "Mental and Physical Measurements of Working Children." PsM, 1914: No. 1.

103. Yerkes, R. M. (Editor). "Psychological Examining in the United States Army." Memoirs, National Academy of Sciences, 15.

A detailed account of the field outlined in the title.

III. Specific Tests

A. Language Tests

104. Brown, H. A. "The Measurement of Ability to Read." Department of Public Instruction, Bureau of Research, Concord, N. H., Bulletin No. 1, 1916.

105. Burgess, M. A. "The Measurement of Silent Reading." Russell Sage Foundation, 1921.

Detailed account of author's Silent Reading Test.

106. Ebbinghaus, H. "Ueber eine neue Methode zur Prüfung geistiger Fähigkeiten und ihre Anwendung bei Schulkindern." Zeitsch. für Psych. und Phys. der Sinnesorgane, 1897: 13 pp. 401–457.

107. Gates, A. I. "An Experimental and Statistical Study of Reading and Reading Tests." JEdPs, 1921: pp. 303–314; 378–391; 445–464.

108. Gray, W. S. "Studies of Elementary School Reading Through Standardized Tests." University Chicago Press, 1917: 1.

109. Kelley, T. L. "Individual Testing with Completion Test Exercises." TCRec, 1917: pp. 371–382.

110. Kelly, F. J. "The Kansas Silent Reading Tests." JEdPs, 1916: pp. 63–80.

111. McCall, W. A. "Proposed Uniform Method of Scale Construction." TCRec, 1921: 22, pp. 31–51.

112. Monroe, W. S. "Monroe's Standardized Silent Reading Tests." JEdPs, 1918: pp. 303–312.

113. Monroe. "A Report on the Use of the Kansas Silent Reading Tests with Over 100,000 Children." JEdPs, 1917: pp. 600–608.

114. Pintner, R., and Gilliland, A. R. "Oral and Silent Reading." JEdPs, 1916: pp. 201–212.

115. Pintner, and Paterson, D. G. "The Ability of Deaf and Hearing Children to Follow Printed Directions." PedSem, 1916: pp. 477–497.

116. Pintner, and Toops, H. A. "A Revised Directions Test." JEdPs, 1918: pp. 123–142.

117. Sackett, L. W. "Tests for Mental Alertness." JEdPs, 1920: pp. 430–444.

118. Starch, D. "The Measurement of Efficiency in Reading." JEdPs, 1915: pp. 1–24.

119. Terman, L. M. "The Vocabulary Test as a Measure of Intelligence." JEdPs, 1918: pp. 452–466.

120. Trabue, M. R. "Completion Test Language Scales." ColConEd, 1916: 77.

121. Trabue. "Key for Completion-Test Language Scales," Teachers' College, 1917.

122. Whipple, G. M. "Vocabulary and Word-Building Tests." PsR, 1908: pp. 94–105.

B. Reasoning, Ingenuity, and Imagination Tests

123. Bassett, D., and Porteus, S. D. "Sex Differences in the Porteus Maze Test Performance." TrScB, 1920: 22.

124. Bonser, F. G. "The Reasoning Ability of Children." ColConEd, 1910: 37.

125. Bonser. "The Selective Significance of Reasoning Ability Tests." JEdPs, 1916: pp. 187–200.

126. Bowler, A. C. "A Picture Arrangement Test." PsC, 1917: pp. 37–54.

127. B own, W., and Whittell, F. "Yerkes' Multiple Choice Method with Human Adults." JCoPs, 1923: pp. 305–326.

128. Chassell, L. M. "Tests for Originality." JEdPs, 1916: pp. 317–328.

129. Garth, T. R. "The Psychology of Riddle Solution: An Experiment in Purposive Thinking." JEdPs, 1920: pp. 16–33.

130. Gault, R. H. "Picture Completion." JApPs, 1920: pp. 310–315.

131. Goodenough, F. L. "The Measurement of Intelligence by Drawings." World Book Co., 1926.

Description of an unusual method of measuring intelligence. Includes the author's scale to be used in evaluating spontaneous drawings of children.

132. Hamilton, G. V. "A Study of Trial and Error Reactions in Mammals." Journal Animal Behavior, 1911: pp. 33–66.

133. Healy, W. "A Pictorial Completion Test." PsR, 1914: pp. 189–203.

134. Healy. "Pictorial Completion Test II." JApPs, 1921: pp. 225–239.

135. Heilbronner, K. "Zur klinisch-psychologischen Untersuchungs Technik." Monatschrift f. Psychiatrie u. Neurologie, 1905: pp. 115–132.

136. Jones, V. A. "A Study of Children's Ability to Note Similarities and Differences." JEdPs, 1925: pp. 253–260.

137. McGeoch, J. A. "The Relationships between Three Tests of Imagination and Their Correlation with Intelligence." JApPs, 1924: pp. 439–443.

138. Parsons, C. J. "Children's Interpretation of Ink Blots." BrJPs, 1917: pp. 74–92.

139. Perry, D. E "Interpretation of the Reactions of the Feeble-Minded on the Healy Pictorial Completion Test II — Social Implications." JDel, 1922: pp. 75–85.

140. Peterson, J. "The Backward Elimination of Errors in Mental Maze Learning." JExPs, 1920: pp. 257–280.

141. Pintner, R., and Anderson, M. M. "The Picture Completion Test." Warwick and York, 1917.

Detailed account of the authors' work with Pictorial Completion I.

142. Porteus, S. D. "Guide to the Porteus Maze Test." Vineland, N. J., Training School, 1924. Pub. No. 25.

Summary of the author's work with his maze tests, and his conclusions as to their scope.

143. Porteus. "The Measurement of Intelligence, 653 Children Examined by the Binet and Porteus Tests." JEdPs, 1918: pp. 13–31.

144. Shaw, E. "A New Picture Completion Test." JApPs, 1918: pp. 355–365.

145. Sherman, I. C. "A Study of Kraepelin's Continuous Subtraction Test." JAbSoPs, 1924: pp. 385–388.

146. Skaggs, E. B. "A Comparison of Results Obtained by the Terman Binet Tests and the Healy Picture Completion Test." JEdPs, 1920: pp. 418–420.

147. Stone, C. W. "Standardized Reasoning Tests in Arithmetic and How to Utilize Them." Teachers College, 1916.

148. Winch, W. H. "Some New Reasoning Tests Suitable for the Mental Examination of School Children." BrJPs, 1914: pp. 190–225.

149. Winch. "Some Relations between Substance Memory and Productive Imagination in School Children." BrJPs, 1911: pp. 95–125.

150. Yerkes, R. M. "The Mental Life of Monkeys and Apes: A Study of Ideational Behavior." Behavior Monograph, 1916: 3.

151. Yerkes. "A New Method of Studying the Ideational Behavior of Mentally Defective and Deranged as Compared with Normal Individuals." JCoPs, 1921: pp. 369–394.

152. Young, H. H. "Slot-Maze A." PsC, 1922: pp. 73–82.

C. Information Tests

153. Bell, J. C. "A Detailed Study of Whipple's Range of Information Test." JEdPs, 1917: pp. 475–482.

154. Eastman, E. "An Information Test Applied to Juvenile Delinquents." JApPs, 1926: pp. 202–215.

155. Pressey, S. L., and Shively, I. M. "A Practical Information Test for Use with Delinquents and Illiterate Adults." JApPs, 1919: pp. 374–380.

156. Smith, L. L. "Whipple's Range of Information Test." PsR, 1913: pp. 517–518.

157. Whipple, G. M. "A Range of Information Test." PsR, 1909: pp. 347–351.

D. Association Tests

158. Arthur, G. "A Standardization of Certain Opposites for Children of Grade School Age." JEdPs, 1923: pp. 483–495.

159. Cattell, J. McK., and Bryant, S. "Mental Association Investigated by Experiment." Mind, 1889: pp. 230–250.

160. Greene, H. A. "A Standardization of Certain Tests." JEdPs, 1918: pp. 559–566.

161. Jacobs, J. "Experiments on 'Prehension.'" Mind, 1887: pp. 75–79.

162. Kent, G. H., and Rosanoff, A. J. "A Study of Association in Insanity." AmJIn, 1910: pp. 4–96; 317–390.

163. King, I, and Gold, H. "A Tentative Standardization of Certain 'Opposites Tests.'" JEdPs, 1916: pp. 459–482.

164. Means, M. H. "A Tentative Standardization of a Hard Opposites Test." PsM, 1921: No. 1.

165. Pintner, R., and Renshaw, S. "A Standardization and Weighting of 200 Analogies." JApPs, 1920: pp. 263–273.

166. Rosanoff, I. R., and Rosanoff, A. J "A Study of Association in Children." PsR, 1913: pp. 43–89.

167. Van Wagenen, M. J. "Graded Opposites and Analogies Tests." JEdPs, 1920: pp. 240–263.

168. Wells, F. L. "Some Properties of the Free Association Time." PsR, 1911: pp. 1–23.

169. Woodrow, H., and Lowell, F. "Children's Association Frequency Tables." PsM, 1916: No. 5.

170. Woodworth, R. S., and Wells, F. L. "Association Tests." PsM, 1911: No. 5.

171. Wylie, A. T. "The Opposites Test." ColConEd, 1925: 170.

E. Memory and Learning Tests

172. Achilles, E. M. "Experimental Studies in Recall and Recognition." ArPs, 1920: 44.

173. Bond, N. J., and Dearborn, W. F. "The Auditory Memory and Tactual Sensibility of the Blind." JEdPs, 1917: pp. 21–26.

174. Clark, S. "Correlation of the Auditory Digit Memory Span with General Intelligence." PsC, 1924: pp. 259–260.

175. Gates, I. "The Mnemonic Span for Visual and Auditory Digits." JExPs, 1916: pp. 393–403.

176. Gray, C. T. "A Comparison of Two Types of Learning by Means of a Substitution Test." JEdPs, 1918: pp. 143–158.

177. Humpstone, H. J. "Memory Span Tests." PsC, 1919: pp. 196–200.

178. Mitchell, D. "Variability in Memory Span." JEdPs, 1919: pp. 445–457.

179. Peterson, J. "The Comparative Abilities of White and Negro Children." CoPsM, 1923: No. 5.

180. Peterson. "Experiments in Rational Learning." PsR, 1918: pp. 443–467.

181. Peterson. "Learning When Frequency and Recency Factors Are Negative." JExPs, 1922: pp. 270–300.

182. Peterson. "The Rational Learning Test Applied to 81 College Students." JEdPs, 1920: pp. 137–150.

183. Peterson. "Tentative Norms in the Rational Learning Test." JApPs, 1920: pp. 250–257.

184. Pintner, R. "The Standardization of Knox's Cube Test." PsR, 1915: pp. 377–401.

185. Pintner and Paterson, D. G. "A Comparison of Deaf and Hearing Children in Visual Memory for Digits." JExPs, 1917: pp. 76–88.

186. Rachofsky, L. M. "Speed of Presentation and Ease of Recall in the Knox Cube Tests." PsB, 1918: pp. 61–64.

187. Shaw, J. C. "A Test of Memory in School Children." PedSem, 1896: pp. 61–78.

188. Starr, A. S. "The Diagnostic Value of the Audito-Vocal Digit Memory Span." PsC, 1923: pp. 61–84.

189. Wells, F. L., and Martin, H. A. "A Method of Memory Examination Suitable for Psychotic Cases." AmJIn, 1923: pp. 243–257.

F. Mechanical and Assembly Tests

190. Doll, E. A. "The Painted Cube Construction Test." JEdPs, 1917: pp. 176–178.

191. Hatt, E., and Brandenburg, G. C. "A Proposed Test for Mechanical Ability." Engineering Education, 1921: pp. 114–127.

192. Hutt, R. B. W. "Standardization of a Color Cube Test." PsC, 1925: pp. 77–97.

193. Kelley, T. L. "A Constructive Ability Test." JEdPs, 1916: pp. 1–16.

194. Kohs, S. C. "The Block-Design Tests." JExPs, 1920: pp. 357–376.

195. Kohs. "Intelligence Measurement." Macmillan, 1923.
Detailed description of author's block-design tests used as an intelligence scale.

196. Maxfield, F. N. "Design Blocks: A Description of a Simple Clinical Test." PsC, 1925: pp. 98–109.

197. Stenquist, J. L. "Measurements of Mechanical Ability." ColConEd, 1923: 130.

198. Whitman, E. C. "A Brief Test Series for Manual Dexterity." JEdPs, 1925: pp. 118–123.

G. Form Board and Construction Board Tests

199. Bronner, A. F. "Construction Test A of the Healy-Fernald Series." PsC, 1916: pp. 40–44.

200. Dearborn, Anderson, Christiansen. "Form Board and Construction Tests of Mental Ability." JEdPs, 1916: pp. 445–458.

201. Dearborn, Shaw, Lincoln. "A Series of Form Board Tests of Intelligence." Harvard Monographs in Education, Series 1, No. 4, 1923.

202. Dunham, F. L. "Arrow Board; an Adult 'Form Board' Test." PedSem, 1916: pp. 283–289.

203. Ferguson, G. O. "A Series of Form Boards." JExPs, 1920: pp. 47–58.

204. Goddard, H. H. "The Adaptation Board as a Measurement of Intelligence." TrScB, 1915: pp. 182–188.

205. Goddard. "The Form-Board as a Measure of Intellectual Development in Children." TrScB, 1912: pp. 49–51.

206. Ide, G. G. "The Witmer Form Board and Cylinders as Tests for Children Two to Six Years of Age." PsC, 1918: pp. 65–88.

207. Kephart, A. P. "Clinical Studies of Failure with the Witmer Form Board." PsC, 1918: pp. 229–253.

208. Lowe, Shimberg, Wood. "Further Standardization of Construction Tests A and B." JApPs, 1924: pp. 324–338.

209. Paschal, F. C. "A Report on the Standardization of the Witmer Cylinder Test." PsC, 1918: pp. 54–59.

210. Paschal. "The Witmer Cylinder Test." Hershey Press, 1918.

211. Shakow, D., and Kent, G. H. "The Worcester Form Board Series." PedSem, 1925: pp. 599–611.

212. Sylvester, R. H. "The Form Board Test." PsM, 1913: No. 4.

213. Wallin, J. E. W. "Norms for the Seguin Form Board Based on the Averages of Three Trials." JDel, 1921: pp. 381–386.

214. Wallin. "The Peg Form Boards." PsC, 1918: pp. 40–53.

215. Wallin. "Psycho-Motor Norms for Practical Diagnosis." PsM, 1916: No. 2.

216. Witmer, L. "Courses in Psychology at the Summer School of the University of Pennsylvania." PsC, 1911: pp. 245–273.

217. Young, H. H. "Physical and Mental Factors Involved in the Form-Board Test." PsC, 1916: pp. 149–167.

218. Young. "The Witmer Form-Board." PsC, 1916: pp. 93–111.

219. Young and Young, M. H. "The Witmer Form-Board — First Trial Records." PsC, 1923: pp. 85–91.

220. Young, M. H. "Correlation of the Witmer Form-Board and Cylinder Test." PsC, 1916: pp. 112–116.

H. Motor Tests

221. Bagley, W. C. "On the Correlation of Mental and Motor Ability in School Children." AmJPs, 1901: pp. 193–205.

222. Cowdery, K. M. "A Note on the Measurement of Motor Ability." JEdPs, 1924: pp. 513–519.

223. Garfiel, E. "The Measurement of Motor Ability." ArPs 1923: 62.

224. Hewes, A., and Students at Mt. Holyoke. "Standardization of the Whipple-Healy Tapping Test." JApPs, 1922: pp. 113–119.

225. Muscio, B. "Motor Capacity with Special Reference to Vocational Guidance." BrJPs, 1922: pp. 157–184.

226. Perrin, F. A. C. "An Experimental Study of Motor Ability." JExPs, 1921: pp. 24–56.

IV. Supplementary Fields of Testing

(Not an adequate bibliography for these fields; merely references for Part IV of the Manual.)

A. Scales

227. Arthur, G. "A New Point Performance Scale." JApPs, 1925: pp. 390–416.

228. Binet, A., and Simon, T. "Le développement de l'intelligence chez les enfants." L'Année Psychologique, 1908: pp. 1–94.

229. Binet and Simon. "The Development of Intelligence in Children." Kite, E., trans., Vineland, N. J., 1916.

Attempts to give a "complete history and exposition of the measuring scale as Binet left it."

230. Binet and Simon. "La mésure du développement de l'intelligence chez les jeunes enfants." Bulletin Société libre pour l'Etude psych. de l'Enfant, 1911: pp. 187–256.

231. Binet and Simon. "Méthodes nouvelles pour le diagnostic du niveau intellectuel des anormaux." L'Année Psychologique, 1905: pp. 191–244.

232. Burt, C. "La Misura dell'Intelligenza: The Treves Saffiotti Revision of the Binet-Simon Scale." Eugenics Review, 1917: pp. 365–373.

233. De Sanctis, S. "Mental Development and the Measurement of the Level of Intelligence." JEdPs, 1911: pp. 498–507.

234. De Sanctis. "Types et degrés d'insuffisance mentale." L'Année Psychologique, 1906: pp. 70–83.

235. Drummond, W. B. "Observations on the de Sanctis Intelligence Tests." BrJPs 1920: pp. 259–277.

236. Gaw, F. "Performance Tests of Intelligence." Industrial Fatigue Research Board, London, Medical Research Council, 1925.

237. Gaw, F. "A Study of Performance Tests." BrJPs, 1925: pp. 374–392.

238. Goddard, H. H. "The Binet-Simon Measuring Scale for Intelligence, Revised." TrScB, 1911: pp. 56–62.

239. Haines, T. H. "Mental Measurements of the Blind." PsM, 1916: No. 1.

240. Haines, T. H. "A Point Scale for the Measurement of the Blind." JEdPs, 1916: pp. 143–149.

241. Haines, T. H. "Report of New Cases and More Reliable Age Norms of Intelligence by the Point Scale for the Blind." JEdPs, 1919: pp. 165–167.

242. Hayes, S. P., and Irwin, R. B. "Condensed Guide for the Stanford Revision Adapted for Use with the Blind." 1923. Not Published. To be obtained from S. P. Hayes, Mt. Holyoke.

243. Herderschêe, D. "Teste für taubstumme Kinder." Zeitschrift für angewandte Psychologie, 1920: pp. 40–61.

244. Herring, J. P. "Herring Revision of the Binet-Simon Tests." JEdPs, 1924: pp 172–179.

245. Herring, J. P. "Herring Revision of the Binet-Simon Tests. Examination Manual." World Book Co., 1922.

246. Herring, J. P. "Reliability of the Stanford and the Herring Revision of the Binet Simon Tests." JEdPs, 1924: pp. 217–223.

247. Knox, H. A. "A Scale, Based on the Work at Ellis Island for Estimating Mental Defect." JAm Med Assoc, 1914: pp. 741–747.

248. Kuhlmann, F. "Binet and Simon's System for Measuring the Intelligence of Children." Journal Psycho-Asthenics, 1911: pp. 76–92.

249. Kuhlmann, F. "A Handbook of Mental Tests." Warwick and York, 1922.

The author's revision of the Binet-Simon scale.

250. Martin, A. L. "A Contribution to the Standardization of the de Sanctis Tests." TrScB, 1916: pp. 93–110.

251. Parker, B. "The Psychograph of Rossolimo." AmJIn, 1916: pp. 273–293.

252. Plant, J. S. "Psychiatric Value of the Kuhlmann Tests." Archives of Neurology and Psychiatry, 1926: pp. 253–259.

253. Rossolimo, G. "Die Psychologischen Profile." Klinik für psychische und nervöse Krankheiten, 1911: pp. 249–295; 295–326.

254. Squires, P. C. "A Universal Scale of Individual Performance Tests — Examination Manual." Princeton University Press, 1926.

255. Stevens, H. C. "A Revision of the Rossolimo Tests." Titchener Commemorative Volume, pp. 128–149. Worcester, Mass., Louis M. Wilson, Clark University, 1917.

256. Terman, L. M. "The Measurement of Intelligence." Houghton, Mifflin, 1916.

A detailed description of the Stanford Revision of the Binet-Simon tests.

257. Treves, Z., and Saffiotti, F. U. "La 'Scala Metrica dell'Intelligenza' di Binet e Simon." Milano; Stabilimento Tipolitografico G. Cavelli, 1911.

The 1908 scale applied to Italian children.

258. Yerkes, Bridges, Hardwick. "A Point Scale for Measuring Mental Ability." Warwick and York, 1915.

Description of the authors' point scale.

259. Yerkes, and Foster, J. C. "A Point Scale for Measuring Mental Ability." Warwick and York, 1923.

A revision of the Yerkes-Bridges-Hardwick Point Scale with the addition of an infant and an adolescent scale.

B. Group Tests

260. Bird, G. E. "The Rhode Island Intelligence Test." JEdR, 1923: pp. 397–403.

261. Buckingham, B. R., and Monroe, W. S. "A Testing Program for Elementary Schools." JEdR, 1920: pp. 521–532.

262. Dodd, S. "International Group Mental Tests." Princeton, N. J., 1926.

263. Haggerty, M. E. "Intelligence Examination Delta 2." JEdPs, 1923: pp. 257–277.

264. Miller, W. S. "The Administrative Use of Intelligence Tests in the High School." 1923, Twenty-First Yearbook of the National Soc. for the Study of Educ.: pp. 189–222.

265. Pressey, L. W. "A Group Scale of Intelligence for Use in the First Three Grades." JEdR, 1920: pp. 285–294.

266. Pressey, L. W. "The Primary Classification Test." JEdR, 1924: pp. 305–314.

267. Roback, A. A. "Roback Mentality Tests." Simmons College Review, 1921.

268. Thorndike, E. L. "Intelligence Examination for College Entrance." JEdR, 1920: pp. 329–337.

269. Whipple, G. M. "The National Intelligence Tests." JEdR, 1921: pp. 16–31.

C. Educational Tests

270. Ayres, L. P. "A Measuring Scale for Ability in Spelling." Russell Sage Foundation, 1915.

271. Ayres, L. P. "A Scale for Measuring the Quality of Handwriting of Adults." Russell Sage Foundation, 1915, No. E. 138.

272. Ayres, L. P. "A Scale for Measuring the Quality of Handwriting of School Children." Russell Sage Foundation, Bulletin No. 113.

273. Courtis, S. A. "Teachers' Manual for Courtis Standard Practice Tests." World Book Co., 1916.

274. Douglass, H. R. "A Series of Standardized Diagnostic Tests in the Fundamentals of Elementary Algebra." JEdR, 1921: pp. 396–403.

275. Henmon, V. A. C. "The Measurement of Ability in Latin." JEdPs, 1917: pp. 515–538; 589–599; 1920: pp. 121–136.

276. Hines, H. C. "A Guide to Educational Measurements." Houghton, Mifflin, 1923.

Intended to serve as textbook. Rather brief treatment of intelligence tests and more detailed discussion of educational and group tests and statistical methods.

277. Lackey, E. E. "A Scale for Measuring the Ability of Children in Geography." JEdPs, 1918: pp. 443–451.

278. Minnick, J. H. "A Scale for Measuring Pupils' Ability to Demonstrate Geometrical Theorems." School Review, 1919: pp. 101–109.

279. Monroe, DeVoss, Kelly. "Educational Tests and Measurements." Houghton, Mifflin, 1924.

A splendid compilation of educational tests with a discussion of their use, reliability, and application.

280. Starch, D. "The Measurement of Achievement in English Grammar." JEdPs, 1915: pp. 615–626.

281. Thorndike, E. L. "English Composition." Teachers College, 1916.

282. Thorndike, E. L. "Handwriting." TCRec, 1910: pp. 83–175.

283. Van Wagenen, M. J. "Historical Information and Judgment in Pupils of Elementary Schools." ColConEd, No. 101, 1919.

D. Character Tests

284. Downey, J. E. "The Will-Temperament and Its Testing." World Book Co., 1923.

A summary of the author's work in the field of temperament testing.

285. Hartshorne, H., and May, M. A. "Testing the Knowledge of Right and Wrong." Religious Education, 1926: pp. 63–76; 239–252; 413–421.

286. May and Hartshorne. "Objective Methods of Measuring Character." PedSem, 1925: pp. 45–67.

287. Pressey, S. L. "A Group Scale for Investigating the Emotions." JAbPs, 1921: pp. 56–71.

288. Watson, G. B. "The Measurement of Fair-Mindedness." ColConEd, 1925, No. 176.

E. Trade and Vocational Tests

289. Burtt, H. E. "Professor Münsterberg's Vocational Tests." JApPs, 1917: pp. 201–213.

290. Chapman, J. C. "Trade Tests: The Scientific Measurement of Trade Proficiency." Holt, 1921.

Description of various types of trade tests, explanation of the method of their construction and a general discussion of their value.

291. Gilbreth, F. B. "Motion Study." N. Y., Van Nostrand, 1911.

An analysis of the processes required in brick-laying, for the purpose of obtaining more efficient methods.

292. Griffitts, C. H. "Fundamentals of Vocational Psychology." Macmillan, 1924.

Summary of the field of vocational psychology, written particularly for students.

293. Kornhauser, A. W. "The Psychology of Vocational Selection." PsB, 1922: pp. 192–229.

294. Münsterberg, H. "Psychology and Industrial Efficiency." Houghton, Mifflin, 1913.

Discusses and describes the author's tests for ship officers, motormen, etc.

295. Muscio, B. "Lectures on Industrial Psychology." Dutton, 1920.

Series of lectures intended for a general audience, outlining in some detail various types and methods of the application of psychology to industry.

296. "Personnel Manual." (Personnel System of the U. S. Army, Vol. II.) Washington, D. C., 1919.

297. Scott, W. D., and Clothier, R. C. "Personnel Management." N. Y., A. W. Shaw 1923.

A detailed study of the principles and methods of personnel management.

298. Seashore, C. E. "Manual of Instructions and Interpretations for Measures of Musical Talents." Columbia Graphophone Co., N. Y., Educational Department, 1919.

299. Taylor, F. W. "The Principles of Scientific Management." Harper Bros., 1914. (Private circulation among members of American Society of Mechanical Engineers, 1911.)

Discussion of the practical value of the application of science to industry.

300. Thurstone, L. L. "A Standardized Test for Office Clerks." JApPs, 1919: pp. 248–251.

301. Toops, H. "Tests for Vocational Guidance of Children 13–16." ColConEd, 1923. No. 136.

V. Statistical Reference Books

302. Garrett, H. E. "Statistics in Psychology and Education." Longmans Green, 1926.

A thoroughly readable and clear exposition of statistical methods with special attention to the needs of psychologists and educators.

303. McCall, W. A. "How to Measure in Education." Macmillan, 1922.

An exposition of statistical methods as applied to educational tests, including a detailed description of the T scale.

304. Monroe, W. S. "An Introduction to the Theory of Educational Measurements." Houghton, Mifflin, 1923.
Deals with the construction and application of educational tests.

305. Rugg, H. O. "Statistical Methods Applied to Education." Houghton, Mifflin, 1917.
A clear exposition of the field outlined in the title.

VI. Bibliographical Compilations

A. General

306. Boardman, H. "Psychological Tests — A Bibliography." N. Y. Bureau of Educational Experiments. Bulletin No. 6, 1917.

307. Mitchell, D., and Ruger, G. "Psychological Tests Revised and Classified: Bibliography." N. Y. Bureau of Educational Experiments, Bulletin No. 9, 1918.

308. Odell, C. W. "An Annotated Bibliography Dealing with the Classification and Instruction of Pupils to Provide for Individual Differences." University of Illinois, Bulletin No. 16, Urbana, 1923.

309. Pintner, R. "Intelligence Tests." PsB, 1926: pp. 366–381.

B. Scales

310. Kohs, S. C. "The Binet-Simon Measuring Scale for Intelligence: An Annotated Bibliography." JEdPs, 1914: pp. 215–224; 279–290; 335–346.

311. Kohs, S. C. "An Annotated Bibliography of Recent Literature on the Binet-Simon Scale (1913–1917)." JEdPs, 1917: pp. 425–438; 488–502; 559–565; 609–618.

C. Group

312. Bell, J. C. "Group Tests of Intelligence; an Annotated List." JEdPs, 1921: pp. 103–108.

313. Whipple, G. M. "An Annotated List of Group Intelligence Tests." 1923, Twenty-first Year-Book. National Society for the Study of Education, Bloomington, Ill., pp. 93–113.

D. Educational

314. Bryner, E. "A Selected Bibliography of Certain Phases of Educational Measurement." 1918, Seventeenth Year-Book. National Society for the Study of Education, Part II, pp. 161–190.

315. Jones, V. A., and McCall, W. A. "Educational Tests." PsB, 1926: pp. 382–394.

E. Character

316. May, M. A., and Hartshorne, H. "Personality and Character Tests." PsB, 1926: pp. 395–411.

317. Symonds, P. M. "Present Status of Character Tests." JEdPs, 1924: pp. 484–498.

F. Trade and Vocational

318. Brewer, J. M., and Kelly, R. W. "A Selected Critical Bibliography of Vocational Guidance." Harvard Bulletin in Education, No. 4, 1917.

319. Manson, G. E. "Bibliography on Psychological Tests and Other Objective Measures in Industrial Personnel." Journal Personnel Research, 1925: Nos. 7 and 8.

PUBLISHERS AND MANUFACTURERS OF TEST MATERIAL

Bureau of Educational Tests and Measurements, Emporia, Kansas: Test 28.

Dunham, F. L., 1111 N. Eutaw Place, Baltimore, Md.: Test 70.

Goudge, M. C., Chapel Hill, N. C.: Tests 113, 123.

Harvard Psycho-Educational Clinic, Cambridge, Mass.: Tests 79–82, 105, 107, 109.

Institute of Educational Research, Teachers College, N. Y.: Test 56.

Kent, G. H., % Judge Baker Foundation, Boston, Mass.: Tests 97, 125.

Milton Bradley, Springfield, Ill.: Test 59.

O'Connor, F., General Electric Co., Lynn, Mass.: Test 62.

Public School Publishing Co., Bloomington, Ill.: Test 26.

Richter, F. A., & Co. 215 Pearl St., New York, N. Y. Test 74.

Russell Sage Foundation, N. Y. City: Test 27.

Stoelting Co., 424 N. Homan Ave., Chicago, Ill.: Tests 1, 5, 7–9, 12, 17, 19–25, 30, 32–34, 37, 38, 41–49, 52–55, 57, 58, 60, 61, 63–69, 71–73, 76–78, 83, 84, 86–92, 94–96, 98, 100, 102–104, 111, 112, 115–118, 120–122, 124.

Teachers College, N. Y. City: Tests 10, 11, 29.

Training School, Vineland, N. J.: Test 93.

University of Pennsylvania, Psychological Laboratory and Clinic, Philadelphia, Pa.: Tests 75, 85.

Material for Tests 58, 67, 74 may be purchased at toy stores.

We have recently been informed by the following that they are engaged in the manufacture of some of the test material mentioned in this volume:

Marietta Apparatus Company, Marietta, Ohio.

Wilson Veneer Company, Rome, N. Y.

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